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CONTENTS

The American Association for the Advancement of Science:—
Engineering as a Profession and its Relation to the American Association for the Advancement of Science: PROFESSOR GEORGE F. SWAIN 81
The Chemical Regulation of the Processes of the Body by Means of Activators, Kinases and Hormones: PROFESSOR WILLIAM H. HOWELL 93
Sir William Crookes: PROFESSOR CHARLES BASKERVILLE 100
The International American Congress of Medicine and Hygiene 103
Scientific Notes and News 104
University and Educational News 108
Discussion and Correspondence:—
International Language: PROFESSOR OTTO JESPERSEN. *Scientists and Esperanto:* J. D. HAILMAN. *Relativity and some of its Consequences:* PROFESSOR FRANCIS E. NIPHER. *"Geometrical" Canals on Mars?—A Suggestion:* PROFESSOR R. G. AITKEN 109
Scientific Books:—
Davidson on the Human Body and Health: PROFESSOR THOMAS A. STOREY. *Lepidoptera Phalænæ:* DR. HARRISON G. DYAR .. 115
Scientific Journals and Articles 117
The American Mathematical Society: PROFESSOR F. N. COLE 118
Societies and Academies:—
The Society for Experimental Biology and Medicine: DR. EUGENE L. OPIE. *The Academy of Science of St. Louis:* MARY J. KLEM. *The American Chemical Society—New York Section:* DR. C. M. JOYCE, *Rhode Island Section:* ALBERT W. CLAFLIN 119

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ENGINEERING AS A PROFESSION AND ITS RELATION TO THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

IN considering what should be the topic of my brief address as retiring Vice-president of Section D of this association, the question of the relation of the profession of engineering to this association has been forcibly brought before my mind. A number of engineering subjects of interest suggested themselves, in regard to which I might perhaps be able to present to you ideas more or less novel and interesting; but all these subjects seemed, upon consideration, better suited to one of the professional engineering societies. I have therefore concluded to ask your attention for a few minutes to a consideration of the profession of engineering itself and its relation to the American Association for the Advancement of Science.

I do this, in the first place, because the profession is one in the standing and recognition of which I have the deepest personal interest, and, in the second place, because I have even within a few months been made to realize that many well informed people deny that engineering is a profession at all or the engineer a professional man in the proper sense of the term; and, in the third place, because the relation of the profession to this association seems to have long been a matter of doubt and

[1] Address of the vice-president and chairman of Section D—Mechanical Science and Engineering. American Association for the Advancement of Science, Boston, December 29, 1909.

uncertainty. Many people seem to think that the engineer is neither a scientist nor a professional man, nor yet a business man strictly speaking, but that he is something betwixt and between—some one to be employed for certain technical work.

According to the dictionary, a profession is defined as "a vocation in which a professed knowledge of some department of science or learning is used by its practical applications to the affairs of others, either in advising, guiding or teaching them, or in serving their interests or welfare in the practise of the art founded on it. Formerly, theology, law and medicine were specifically known as the professions, but as the applications of science and learning are extended to other departments of affairs, other vocations also receive the name. The word implies professed attainments in special knowledge as distinguished from mere skill; a practical dealing with affairs as distinguished from mere study or investigation; and the application of such knowledge to uses for others as a vocation as distinguished from its pursuit for one's own purpose.

Up to the present time the art involved in the work of engineering has been more recognized than the science. The engineer has been considered rather a builder than a scientific man, pursuing an occupation rather than a profession.

At a meeting of the council of the Institution of Civil Engineers of Great Britain held on December 29, 1827, it was *Resolved;* that Mr. Tredgold be written to, requesting him to define the objects of the Institution of Civil Engineers, and to give a description of what a civil engineer is, in order that this description and these objects may be embodied in a petition to the Attorney General in application for a charter." At the following meeting of the council, on January 4, 1828, a communication from Mr. Tredgold was read and entered in the minutes, bearing the title: "Description of a Civil Engineer, by Thomas Tredgold, Hon. M.Inst.C.E.," as a result of which the charter of the institution describes the profession of the civil engineer as "the art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states for both external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange; and in the construction of ports, harbors, moles, breakwaters and lighthouses; and in the art of navigation by artificial power for the purposes of commerce, and in the construction and the adaptation of machinery, and in the drainage of cities and towns."

Since Tredgold's time, however, fields then unsuspected have been added to the profession of engineering, amply justifying the prediction that he made, that the extent of the profession "is limited *only by the progress of science,*" and that "its scope and utility will be increased with every discovery in philosophy, and its resources with every invention of the mechanical or chemical arts, since its bounds are unlimited, and equally so must be the resources of its professors."

But in order to sketch even inadequately the scope of engineering, I must ask you to follow with me briefly the historical development of the profession.

The vocation of engineering is as ancient as any of man's occupations. No doubt from the earliest times man has been subject to disease, and *the healing art* in more or less crude form has been practised; man, naturally a quarrelsome animal, has also from the earliest time engaged in disputes with his neighbors, and in more or less crude form the *law* has had to be ad-

ministered; and, once more, from the most primitive times, man has realized the presence of some supernatural power, which the *priest,* if only under the title of "medicine man," has endeavored to propitiate. But clearly, man has always required water and food, and has dug wells and employed crude means for raising water and of growing crops. He has also needed habitations, and has required the services of men to build them, so that the hydraulic and the structural engineer or architect may at least claim that their profession is as old as any.

As civilization developed, the work of the engineer or builder developed equally. The Assyrians and Babylonians built arches and bridges, the inhabitants of India built great reservoirs, the Egyptians built pyramids, the Romans built roads, bridges, aqueducts, baths and other important works, many of them of great extent and requiring great skill. But when we read that the construction of one of the pyramids of Egypt required the labor of 360,000 men for twenty years, we see that the work of the engineer was not precisely directed to the uses of others, and we realize the crudeness, in some respects, of the civilization which would permit such waste of useful effort. During the middle ages, with the neglect of learning, engineering declined, but with the revival of learning in the sixteenth century it took on new life, and since that time, with the advance of science, it has progressed probably more rapidly than any other field of activity.

During the early development of the profession, engineering came to be divided into two kinds, civil and military, the latter being concerned with fortifications and with means of offense and defense, while the former included all other applications of the building art. Up to nearly the end of the eighteenth century, Tredgold's definition was somewhat inapplicable, inasmuch as the *sources of power* in nature were not understood, and could be utilized only to a very small degree. Up to that time, engineering comprised mainly the construction of roads, canals and bridges, the improvement of harbors, river works, the construction of docks, and the supplying of towns and cities with water. The state of the art only allowed of the construction of bridges of very short span, of either stone or wood, since iron had not yet been brought into use, and ferries were generally employed in crossing streams too deep for fording. The steam engine was known only in a very crude and uneconomical form, the weaving of cloth was almost all done by hand, there was little transportation except by sea, cities were not drained or lighted by gas, the applications of electricity were, of course, unknown, navigation by water was entirely by means of sailing vessels or with oars, and the only form in which iron was used to any extent was in the form of cast iron.

But before the end of the eighteenth century there came a remarkable series of mechanical inventions—the spinning jenny by Hargreaves, the spinning frame by Arkwright, the mule by Crompton, the power loom by Cartwright, the modern steam engine by Watt, the puddling process for making wrought iron by Cort, and others. These were followed, in the first third of the eighteenth century, by the development of the steam locomotive by Stephenson, of the steamboat by Fulton, by the inauguration of the era of railroads, beginning for all practical purposes with the victory of the "Rocket" in the competition at Rainhill in 1829, and by the further great improvements in manufacturing, and in the production of iron and steel.

It was just at this time, when the minds of all were filled with the inventions of Watt and of Stephenson, that Tredgold gave his definition, clearly showing the tremendous influence held at that time by the subject of *power*. These great developments greatly enlarged the field of engineering, and gave birth to a new class of engineer—the railroad engineer. They led also to the differentiation of the mechanical engineer from the civil engineer. Since that time the mechanical engineer has claimed as his special field the development and use of power in all its forms, including the generation of power from the combustion of fuel and the flow of water, by means of the various types of engines and water wheels, the transmission of that power from point to point by means of belting, shafting or other means, and the utilization of that power by machinery. There is hardly a field of human industry, therefore, which is not dependent upon the mechanical engineer, because all manufactured articles depend upon power in some application, and upon machinery operated by power. The field of the modern mechanical engineer, however, not only covers the department of power and its applications—in manufacturing, in the steam locomotive, in the steamship—but it is also held to include the construction of mills, and all applications of steam and heat, such as heating, ventilation, lighting, refrigeration, ice making, elevators and so on.

But notwithstanding the differentiation from it of the field of the mechanical engineer, the field of the civil engineer was itself enlarged by the progress of science and invention. The great impetus given to manufacturing rendered necessary the distribution of the raw material and of the manufactured products. Transportation engineering was enormously increased in its scope, and the new profession of the railroad engineer was brought into existence. Roads and canals, harbors and docks were built with unexampled rapidity and river improvements were extensively carried on. At this time the increasing use of canals gave occasion for the celebrated remark of Brindley, the great canal engineer of England, himself an untutored genius, who, when asked what the use of a river was, replied "to supply canals with water." At the same time the economical production of wrought iron rendered possible the construction of bridges of unexampled span.

By this time had begun one of the greatest sociological movements which characterizes the present time, namely, the increasing congregation of people in cities. At the beginning of the nineteenth century only 3 per cent. of the population of the United States lived in cities, while at the present time the urban population is over 33 per cent. of the total. This phenomenon, during the last half of the century just passed, has led to the differentiation of another field of engineering, namely, that of the sanitary engineer, whose specific province it is to deal with the problems of water supply, drainage, the disposal of refuse, the purification of water and sewage, the sanitation of dwellings, and the various other problems resulting from this congestion of population.

Improvements, also, in chemistry and in metallurgy, have given rise to still other distinct branches of engineering, namely, mining engineering and metallurgy, the scope of which I will not endeavor here to sketch.

Again, the field of the mechanical engineer has during the past quarter of a century become subdivided, owing to the discoveries in electricity. Steam and water are no longer used simply to propel steam

engines or water wheels, producing power to be used on the spot. Steam or other engines, and water wheels, now drive electric generators, the currents from which are transmitted long distances, sometimes as great as 200 or even 300 miles, by means of transmission wires, to be again transformed by electric machinery and used for the production of light or for other purposes. The telephone and the telegraph have been discovered, electric cars have replaced the horse cars, and the passenger traffic of our steam railroads is in some cases being carried on by electric locomotives. Almost everything now-a-days *is* done or *can be* done by electricity, even to preparing our food and heating our houses. The electrical engineer, with a field already so wide that it is divided into specialties, is a product of the last twenty-five years.

Notwithstanding all these differentiations, even the field of the civil engineer keeps on increasing in scope. Coasts have to be protected from the sea, swamp and marsh lands reclaimed, large areas irrigated by artificial means, requiring the construction of great dams, the storing of immense quantities of water and the distribution of that water by means of canals into the uplands. Problems of urban transportation present themselves and must be solved by the construction of subways and tunnels, great railroad terminals have to be provided, and skyscrapers constructed.

Also, the development of electrical power, and the increasing scarcity and waste of fuel, has increased enormously the importance and value of water powers. The question of the discharge of rivers, the means of increasing it, of storing it so as to make it more regular from month to month, thus avoiding the damage due to floods, and increasing the power during dry seasons, the construction of dams and of the various works incident to the development of water powers, all these together with other problems now constitute a separate field, that of the hydraulic engineer. Water, at once the most valuable and necessary of the gifts of nature, and at the same time an enemy to be dreaded and feared, must be controlled and governed, so that communities may be supplied adequately with this necessity of life and the power generated by the rivers turned to the service of man. The laws of water flowing in conduits, through pipes and in open channels, must be studied and experimented upon, and the science of the laws of water—hydraulics—is steadily increasing in value and in importance.

But the field of the engineer is not yet exhausted. The increase in transportation by sea, the use of steel for ships, and the ever-increasing size of vessels, led to the profession of the naval architect, itself a large field, dealing with the applications of steel and other materials to the construction of vessels, and the proper equipment of these vessels. The naval architect builds the vessels, the marine engineer equips them with machinery and provides them with ventilating and other apparatus necessary to fit them for their use.

Finally, investigations in the various fields of applied chemistry, as for instance in the production of gas, in the manufacture of rubber, soap, glue and other materials too numerous to mention, have led in recent years to the formation of still another branch of the profession, namely, that of the chemical engineer, who deals with the applications of chemistry to the useful arts. To even enumerate the application of this science would tax your patience.

It will be evident from the foregoing brief review, that the field of engineering

is more extensive than that of any of the three so-called learned professions, and that the different branches of the profession differ from each other to such an extent as in some cases to have little in common, except a knowledge of the general principles of physics, chemistry, mechanics and other sciences. The profession of the physician, it is true, is divided into many specialties, but while the throat specialist deals with the throat, and the stomach specialist with the stomach, they are all dealing with the human body, in which all the parts and functions are closely interconnected; but even within the field of what is termed civil engineering, the railroad engineer and the irrigation engineer, or the railroad engineer and the architectural engineer, have little in common. Assuredly Tredgold was right when he said that the bounds of the profession are unlimited.

The work of the engineer as applied to any contemplated project consists essentially of four parts: first, to ascertain whether anything should be done, and if so, what should be done; second, to design and formulate the means to be employed in doing it; third, to select the proper materials; and, fourth, to carry on the actual work into execution. As the engineer's problem is to adapt the materials, the forces, the sources of power in nature to the use and convenience of man, it is clear that in order to fulfil his calling to the highest extent, the engineer should be scientifically trained, that he should be familiar with the fundamental principles which govern natural phenomena. Different branches of science are required in varying degrees in the different branches of the profession, but every engineer should know, and know thoroughly, the fundamental principles of chemistry, physics, mathematics and mechanics. The engineer should be possessed of the true scientific spirit, loving the study of science for its own sake as well as for its applications and trained to seek always the truth, the whole truth and nothing but the truth. But the work of the engineer deals not with science for its own sake, but with its applications to the practical affairs of men. The engineer must, therefore, be above all a *practical man*. He must not be a pure theorist, a dreamer, a visionary. He must see in his mathematical formulæ a meaning, and not a simple accumulation of letters. The engineer, then, must not only be a scientific man but he must be first and foremost a practical man. And on the whole, the latter is more important than the former, although it is in the proper combination of the two that the greatest excellence will result.

The engineer, unlike the true scientist or mathematician, does not work in his laboratory or his study; his work is with the affairs of men. Engineering is more than half business, and the successful engineer, therefore, must be to a considerable extent a *business man* and a *financier*. As already remarked, the most important problem, and the first he has to solve, is whether anything should be done in a given case, and if so, what? The engineer must not build a fine bridge with costly peculiarities, difficult to execute, for the sake of leaving a monument behind him. He must continually remember that engineering is not simply adapting the forces of nature to the use of man, but that it is adapting them economically and properly. More important than the question *how* a bridge shall be built is the question *whether* it shall be built. More important than the question *how* a railroad shall be located is the question *whether* it shall be located and *where* it shall be located. The decision of these questions requires finan-

cial and business ability of a high order, combined with a clear insight into the practical relations of things. The railroad engineer must study the manufacturing and economic conditions affecting a country through which a proposed railroad is to pass; he must consider the traffic on existing roads through that country, the relative importance of the cities, whether there is a possibility of increasing the agricultural or manufacturing product, whether the road should run in a comparatively straight line between two large towns or whether it should be diverted a number of miles in order to tap a smaller town or whether that smaller town should be reached by a branch from the main line; and many similar questions. It is clear that Tredgold's definition is faulty because it does not emphasize economy.

It is also evident that the engineer should have the large view. He has the opportunity to worse than waste the money of his employers. The engineer who concentrates his whole attention on details of construction may be a good subordinate—and even good subordinates are rare—but he will lack the essentials of the highest success.

Even after the construction of works is entered upon, the duties of the engineer will largely relate to business. He draws up the contracts for the work, estimates each month how much has been completed, certifies payments to the contractor, settles disputes, and in general attends to all the business, except legal matters, connected with the carrying out of the enterprise. He must be an organizer, and must know how large a force is necessary to superintend the work, and how to dispose it to the best advantage and with the greatest economy. It is evident, also, and this is extremely important, that the engineer must be a student of men—not a recluse, but a man among men; and upon his social qualities, upon his ability to get on tactfully with other men and his power of impressing his ideas upon others, will his success largely depend.

One of the most important functions of the engineer is to be able to determine the proper materials to use in his work, to know how to obtain them, and to know how to assure himself that he has obtained them. This function includes a wide range of scientific and practical knowledge. He must not only know the mechanical, chemical and physical properties of materials, such as building stones, timber, steel, iron, cement, paint, asphalt, etc., but he must know what particular material is best adapted to the particular work he has to do, and how to test it and so make sure that the desired qualities are obtained. Probably more engineering failures have been due to faults of material than to any other defect, although it is a common mistake of students to suppose that the work of the engineer is largely the designing of works by the use of mathematical formulæ.

It is evident from the foregoing that not only is the profession of the engineer a wide and varied one, but that it requires varied qualifications, and demands preeminently an all-round man. It must not be forgotten, however, that without the scientific training, or at least the scientific spirit, the engineer will not attain the highest success. It is also evident that the thoroughly trained and capable engineer will find many opportunities to make himself useful in scientific as well as in administrative positions. He will also find many opportunities for doing general public service to the state or nation. Different men have different ideals of success, but the highest ideal is the one which most involves the idea of public service. We have heard a great deal about our natural re-

sources and, indeed, we in this land have been favored in an exceptional degree. We have already done much toward the development of these resources. Our industrial progress in the last one hundred years has been unexampled. But with this great development has gone great waste and extravagance. Our natural resources are being dissipated at a rate which will cause the disappearance of many of them within a comparatively few years if the waste is not checked. To elaborate this subject would require a long time, but you may not be aware of the fact, to cite but one instance, that natural gas is to-day being wasted in this country to such an alarming extent that the waste would be sufficient to light every city in the United States having a population of over 100,000. The engineer is the man who *applies* the resources of nature. He must be the man who also *conserves* those resources. It is probably safe to say that upon him, more than upon any other man, depend the continuance and increase of our prosperity.

The law, medicine and theology have always been considered as the *learned* professions. They are the vocations for which men have been honored *on account of their brains.* After what has been said is it not clear that the engineering profession can claim this distinction to fully as great a degree? Assuredly, such would seem to be the case. But while the three so-called learned professions have been recognized as such for centuries, the profession of engineering, as already said, is the product of the last century and a half. For this and other reasons, it has not been recognized in the popular mind to the extent which its intrinsic importance and the excellence of its work justifies. This is, of course, perfectly natural. In the early days of engineering, centuries ago, the engineer was usually a man engaged also in some other vocation, frequently that of architecture, but sometimes that of the statesman, administrator, mathematician, lawyer, soldier or even priest. Archimedes was a mathematician, but he also built canals in Egypt and in his last days devoted his scientific knowledge to the defence of his native city of Syracuse against Marcellus. The Emperor Trajan built a remarkable bridge across the Danube; and Julius Cæsar built one across the Rhine; Leonardo da Vinci was not only poet, painter and sculptor, but also a civil and military engineer; and during the middle ages the building of bridges in Europe was undertaken by a monastic order known as the Brothers of the Bridge.

I maintain that the preceding discussion fully establishes the fact that engineering is a profession, that the engineer in the highest sense is a professional man, and further that he should be a scientist at heart. It is equally clear, however, considering the relation of the profession to business that many engineers may be purely business men, practising engineering not in the truly professional sense. This, however, is also true of the law, as many examples might be quoted to illustrate.

When this association was organized in 1848, the great development of engineering which has been sketched in preceding pages was just beginning, but had not progressed far. There were few engineering schools or engineering societies. In this connection the growth of engineering schools and of engineering societies is interesting. The oldest engineering society in this country is the Boston Society of Civil Engineers. It was organized July 13, 1848, and incorporated April 24, 1851. It held sessions until 1856, after which there was a gap until 1874, so that it is

really only during the past thirty-five years that the modern society has existed.

The American Society of Civil Engineers was founded in 1852 and held meetings until 1855, when there was a gap until reorganized in 1867. This society now numbers 4,847 members in all grades.

The American Institute of Mining Engineers was organized in 1871, the American Society of Mechanical Engineers as late as 1880 and the American Institute of Electrical Engineers in 1884.

In England, the first society of engineers was a club organized in 1771 by Smeaton and a few others who met at a tavern. Twenty years later it consisted of nearly twenty members, but of these only fifteen were engineers. A personal difficulty broke up the club, but it was reorganized a year later and existed as late as 1872.

The present Institution of Civil Engineers was an outgrowth from this society and was established January 18, 1818, the renowned Telford being the first president and holding that office from 1820 to 1834. Telford built roads and bridges, canals, river works, docks and lighthouses, drained fens and reclaimed the land from the sea. The railroad era was just beginning, and also that of the water supply, gas lighting and drainage of cities. In the time of Telford the institution never numbered more than 200 members, but between 1840 and 1860 two of the leading English railroad engineers, Robert Stephenson and I. K. Brunel, probably each had a corps of trained engineers under his control as large as the whole membership of the institution in its early days. The institution now has a total membership of 8,627 in all grades. This institution was the first professional body to publish discussions of its papers, others, like the Royal Society, publishing only the papers themselves.

At the time of the declaration of independence there were only two professional schools in the United States—the Medical College in Philadelphia (afterwards the Medical School of the University of Pennsylvania) and the Medical School of King's College (afterward Columbia University). The Harvard Medical School was established in 1782 by the appointment of Dr. John Warren as professor of anatomy and surgery. During the last century, medical schools sprang up with great rapidity, both connected with universities and independent, many of them with very low standards. In 1870, Harvard was the first to demand a new and much higher standard, followed only a few years ago by further raising the standard by requiring a college degree, or its equivalent, for entrance.

The first law school in America was not connected with any college and was established in 1784 at Litchfield, Conn., but was discontinued in 1833. The Harvard Law School was established in 1817, being the earliest connected with a university and authorized to confer degrees in law. In 1897 it was made a graduate school for which a college degree was required for entrance, or a degree of proficiency sufficient for entrance into the senior class at Harvard.

The Yale Law School was established in 1824; that of the University of Virginia in 1825, of the University of Cincinnati in 1833 and of Columbia University in 1858. In 1878, there were fifty law schools in the United States with a total of 3,012 students; in 1901 there were 86 law schools with a total of 11,883 students.

The first engineering school in this country was the Rensselaer Polytechnic Institute at Troy, which was organized in 1824. The Lawrence Scientific School of Harvard and the Sheffield Scientific School of Yale were organized in 1847, and these

were followed during the next twenty years by the Massachusetts Institute of Technology in 1865 and other institutions. Since that time, the number of schools and students has greatly increased, as shown by the following statistics relating to professional schools in 1905:

	Theological Schools	Law Schools	Medical Schools	Schools of Technology Conferring only B.S. Degrees
Number of institutions ...	156	96	148	44
Teachers.....	1,094	1,190	5,465	1,865
Students.....	7,580	14,714	25,835	16,110

The engineering *societies* do not in any case require a technical training as a preparation for membership. The American Society of Civil Engineers requires for full membership that the candidate shall be at least thirty years of age, shall have been in the practise of his profession for ten years and shall have had responsible charge of work for at least five years. Graduation from a technical school is considered equivalent to two years of practical work.

A good illustration of the development of the engineering profession is found in the history of the noted French corps of government engineers known as the Corps des Ponts et Chausseès. It was in the time of Charles V. that professional engineers were first employed by the king to supervise public works, particularly roads, which were known as the king's highways. The corps experienced many vicissitudes, some rulers appreciating their work while others did not. In the time of Louis XIV., the engineers were pushed into the background, the king reserving his favor for the court architects. The architect, Mansard, was entrusted with the building of a bridge across the Allier at Moulins, but he was unacquainted with the principles of hydraulics and could not calculate the volume and force of the water, and did not know how to protect his bridge against floods, so that it collapsed a few years later. This disaster was favorable to the engineers, who pointed out that while it was the duty of architects to build fine palaces, engineers should be entrusted with the construction of public works where convenience and stability were of more importance than elegance. The Corps des Ponts et Chausseès was definitely and permanently organized between 1712 and 1716; and under Louis XV. the noted Ecole des Ponts et Chausseès was constituted by royal decree dated February 14, 1747. It was placed under the direction of the engineer Perronet, who besides other great works had built the beautiful Pont de la Concorde at Paris. At the beginning of the French Revolution, it was proposed to abolish the corps, but this move was defeated by Mirabeau, and, instead, the corps was reorganized by several decrees. The corps is now under the department of public works. Five sixths of its engineers come from the Ecole des Ponts et Chausseès, while one sixth come from foremen, who, after ten years' experience, are entitled to enter a competitive examination and if successful may be appointed engineers.

Perronet remained director of the school for forty-seven years after it was founded in 1747. He died February 27, 1794. The following year the Ecole Polytechnique was founded, giving a general scientific training preparatory to the engineering school. The course in the engineering school extends over three years, offering free tuition in all courses, and state pupils are chosen exclusively from those leaving the Ecole Polytechnique and receive a salary of $360 a year plus $10 monthly during their stay in Paris. During each vacation they are required to spend three and one half

months in practical work under the supervision of one of the engineers of the corps.

From these statements it is evident that engineering schools are of later growth than those in the other learned professions, which in Europe have been established for centuries, and in this country long antedated the technical schools. It is also clear that engineering societies are mostly of more recent origin than this association, and that they do not insist upon a technical or scientific education as a qualification for membership.

It is clear from what has been recited that with the great development of applied science, or engineering, has gone a corresponding development of engineering societies. Each separate branch of engineering is represented by a national society, and there are numerous smaller local societies. While in the old days the American Association for the Advancement of Science may have had attractions for engineers, and may have given them opportunities for scientific discussion of papers not otherwise to be obtained, even this is questionable, and it certainly is not now the case. It is safe to say that important engineering papers will not be presented to this society, or if so presented, will fail to be of their due influence. Section D, however, or what has corresponded to it, does not appear to have ever been of great importance in the American Association for the Advancement of Science. I have examined the records of the association from the beginning and it appears that few, if any, engineering papers of importance have been presented to it, except by title or on abstract, and that these have often been presented in full before professional engineering societies, or in the engineering papers. A majority of the papers before this section have been presented by a very small group of men, including professors in a few engineering schools and some men holding government positions. For many years no papers have been printed in full except the vice-presidential addresses, and in many instances the other papers have all been printed by title only. Even in the early days, or up to 1880, there were many years in which but one paper on applied science was presented, and there were nine years in which no such paper was presented. Section D was first constituted in 1882, although previous to this date the section of mechanical science had been recognized as a branch of the section on mathematics and physics. About this time Professors Trowbridge, Thurston and others began to take some active interest in the society, and their names with those of Burkitt Webb, Wood, Denton and some others are frequently seen in the list of authors, although none of their papers are printed in full in the proceedings. In five years since 1882 there have been no vice-presidential addresses; in the majority of the cases such addresses, like the present one, have not been upon engineering or even scientific topics, but have been distinctly general or educational in character. The attendance at the meetings of the section has, from what information I have been able to gather, been small, and the future of the section has long been a matter of doubt. Professor Storm Bull, in his annual address in 1899, expresses his regret at the somewhat prevailing feeling that the extinction of the section is imminent.

What, then, is the function of Section D as related to the profession of engineering? Has it a useful purpose to subserve?

As a comparatively new member of the association, I venture an opinion on this subject with diffidence, yet as an engineer of some years of experience, and with a somewhat close knowledge of a number of strictly professional societies, possibly it

may be proper for me to do so. In the first place, I confess that when I joined the society I did so not because of its relations to engineering, but because of my interest in some branches of science; not primarily in order to meet engineers or to hear engineering papers, for these ends can much better be obtained in connection with the professional societies, but to have the opportunity to meet men interested like myself in the various branches of pure science. I believe that the membership of this section will in the future, as in the past, consist largely of teachers of engineering who like myself recognize that the profession of engineering is founded upon the principles of science, and who desire to keep alive their interest in and contact with those scientific branches; and that the section can never become an effective means for the discussion of technical engineering subjects. From this point of view, then, I believe that the main benefit of this section, which I hope will continue, will arise in two ways: In the first place, it will be beneficial if its main activities are directed not toward technical engineering subjects, but toward subjects which are more scientific than technical. For instance, the subject of geodesy has not yet been made the basis of a national engineering society in this country, and, indeed, that subject is probably quite as much allied to the science of physics as it is to engineering. Such a subject might well be made a specialty of this section, for it is rarely that we find a discussion of geodetic subjects before any of the engineering societies.

Again, the subject of aeronautics, which I am pleased to see has been made an important feature of the present meeting of this section, seems a peculiarly appropriate field. It is perhaps a fair statement that this subject is as yet more a scientific and experimental one than an engineering one; at all events, it has not yet been taken up to any considerable extent by the engineering societies. Subjects, then, more purely of a scientific character and yet of such concrete nature that they are capable of practical utilization, or may form the basis of engineering applications, may well be emphasized in the meetings of this section.

We must remember that for the engineer, science will in most cases simply afford him a basis for his judgment rather than give absolute results. You have discussed this morning questions regarding the wind and the variation of its velocity and pressure with the height; but no matter how many observations you may make, or how many theories you may formulate, the engineer will still have to depend upon his judgment in providing for the wind pressure upon a modern skyscraper or Eiffel Tower.

In the third place, if I am right in considering that the members of this section, like myself, have their principal interest in the society because of their interest in certain branches of pure science, it would seem that the section might be of benefit if it could hold joint meetings frequently with other sections, and instead of attempting to present a long array of papers, should content itself with a very few having distinct relation to some particular topic assigned to the meeting. Certainly no session has been more interesting or, in my opinion, more profitable, than the joint meeting in Chicago, two years ago, with the mathematical section. Engineers, and particularly teachers of engineering, have, or should have, much in common with teachers of mathematics, chemistry and physics, and even with those in still more distantly related sections. And men in those other sections have, or should have, not less to gain from intercourse with us. My plea, then, is that the main benefit of Section D is not to be derived from its

activity as an association of engineers, that is, as a strictly or even quasi professional organization, but from its relations with the other sections, and that its own activities might well be somewhat curtailed if more intimate relations could be initiated and stimulated with those other sections; and that it should endeavor to present to its members not technical engineering subjects, but rather scientific subjects in branches seldom discussed in the technical engineering societies. Let us remember, then, that engineering is a profession, but that it is founded upon science; that the engineer should be at heart a true scientist, and thoroughly imbued with the scientific spirit. Further, that this association is not a professional society, but a scientific one, and that we come here rather as scientists than as engineers; that through our meetings and our contact with scientists in all branches, we may go forth to our daily practical and business work more thoroughly imbued than ever with a sense of the importance of our profession, and better able to apply economically the materials, forces and laws of nature in the service of man.

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THE CHEMICAL REGULATION OF THE PROCESSES OF THE BODY BY MEANS OF ACTIVATORS, KINASES AND HORMONES[1]

AT the time of Sir Charles Bell physiologists were beginning to realize the great importance of the nervous system as a mechanism for regulating and coordinating the varied activities of the body. To use his own expression, "The knowledge of what is termed the economy of an animal body is to be acquired only by an intimate acquaintance with the distribution and uses of the nerves." Since his time experimental investigations in physiology and clinical studies upon man have combined to accumulate a large fund of information in regard to the regulations and correlations effected through nervous reflexes. No one can doubt that very much remains to be accomplished along these same lines, but in recent years we have come to understand that the complex of activities in the animal body is united into a functional harmony, not only through a reflex control exerted by the nervous system, but also by means of a chemical regulation effected through the blood or other liquids of the organism. The first serious realization of the importance of this second method of regulation came with the development of our knowledge of the internal secretions during the last decade of the nineteenth century. The somewhat meager information possessed at that time in regard to these secretions developed in the fertile imagination of Brown-Séquard to a great generalization, according to which every tissue of the body in the course of its normal metabolism furnishes material to the blood that is of importance in regulating the activities of other tissues. This idea found a general support in the facts brought to light in relation to the physiological activities of the so-called ductless glands, and subsequently in the series of remarkable discoveries which we owe to the new science of immunology. In recent years it has been restated in attractive form by Schiefferdecker in his theory of the symbiotic relationship of the tissues of the body. According to this author we may conceive that among the tissues of a single organism the principle of a struggle for existence, which is so important as regards the relations of one organism to another, is re-

[1] Address of the vice-president and chairman of Section K—Physiology and Experimental Medicine. American Association for the Advancement of Science, Boston, December 28, 1909.

placed for the most part by a kind of symbiosis, such that the products of metabolism in one tissue serve as a stimulus to the activities of other tissues. If a muscle is stimulated to greater growth by an excess of functional activity the substances given off to the blood during its metabolism act favorably upon the growth of other muscles which are not directly concerned in the increased work, or upon the connective tissue surrounding and permeating the muscular mass; and conversely, the development of connective tissue from any cause aids directly by its secretions or excretions in the growth of the muscle. There is thus established a *circulus benignus* by means of which each tissue profits from the functional activity of its fellow tissues. From many sides and in many ways facts have been accumulating which tend to impress the general truth that the co-activity of the organs and tissues may be controlled through chemical changes in the liquid media of the body, as well as through nerve impulses, but in physiology at least we owe the definite formulation of this point of view to Bayliss and Starling. Through their investigations upon secretin they obtained an explicit example of how one organ controls the activity of another organ by means of a specific chemical substance given off to the blood. Other facts known in physiology in regard to the internal secretions were easily brought into line with this definite instance furnished by the secretin, and Starling's convenient term of "hormone," as a general designation for such substances, has served to give a wide currency to the conception. The word and the generalization implied by it have been adopted by investigators in many fields of biological research to explain phenomena of correlation which heretofore it has been impossible to bring under the general rubric of nervous reflexes; phenomena which in fact it has been difficult to express clearly in any precise way such as might serve to stimulate direct experimental investigation. An interesting example of this application of the term and the idea contained in it is found in the theory advanced by Cunningham to explain the development and inheritance of secondary sexual characteristics. This author constructs a system of hypothetical hormones which, if present, would account not only for the development of the secondary sexual characters, as the result of the action of specific hormones furnished by the reproductive cells, but would also make conceivable a method by which these secondary characters, like other somatogenic characters, might affect the germ cells in turn in such a definite way as to be transmitted to the following generations. It is not my purpose to criticize this or similar theories. They will doubtless serve a good purpose in stimulating and directing investigations. It does, however, seem probable that the term hormone, like some of the useful terminology of immunology, will be overworked, and that investigators may deceive themselves as well as others when they conclude that any given relationship is an example of hormone regulation. It has occurred to me that it may be useful in connection with this symposium upon the internal secretions to review very briefly the state of our knowledge in regard to the hormones, with the purpose of discussing somewhat the probable nature of their action and the extent of their distribution.

In treating this subject one must consider also the more or less nearly related instances of combined activity of a chemical sort which are expressed by such terms as chemical activators, kinases and co-ferments. These terms like that of hormone are relatively new, they have been brought

into existence by investigators to explain or to express special reactions connected with metabolism and particularly with the action of ferments. Their precise meaning must be determined by further knowledge of the facts they are intended to describe, but something may be gained by attempting to define them as they are used in physiology at present. The word activator has reference to the fact long known that the ferments, or some of them at least, are secreted in an inactive form, a proferment, which is activated or converted to an active form by a reaction with some definite substance produced elsewhere in the body. Pepsin, for example, is secreted as pepsinogen and is activated to pepsin by the hydrochloric acid formed by other gland cells. Calcium salts are necessary for the activation of the prothrombin, and enterokinase or calcium plays a similar rôle with reference to the trypsinogen. It is to be noted that reactions of this kind are not confined to the ferments. The typical hormone, secretin, exists in the form of an insoluble prosecretin which may be activated by acids, and, according to Delezenne, calcium takes an essential part in the activation of enterokinase, in somewhat the same way as occurs with thrombin. The nature of these activating reactions is not known. The view has been proposed that the inorganic constituents involved, the hydrochloric acid and the calcium for example, act as catalyzers which accelerate a reaction that would occur without their assistance. There is, however, no evidence to show that thrombin is formed in any amount in the absence of calcium salts, nor that pepsinogen yields pepsin without the presence of acids. As Bayliss has pointed out, these reactions belong to the irreversible group, and it is possible that the activator or one of its constituents is represented in the composition of the active substance that is formed. However that may be, it is to be noted that the process of activation is an instance of chemical coordination. The pepsin formed in one kind of gland cell is activated by the acid produced in a different variety of cell. The hydrochloric acid produced in the stomach is carried into the intestine with the flow of chyme and there activates the prosecretin of the intestinal epithelium either directly or indirectly. One tissue, in other words, through its products of metabolism aids another tissue in the performance of its functional duties.

The term kinase is used at present in animal physiology in connection with two reactions only. In both cases it refers to an activating process similar to those just considered, except that the activator is a colloidal substance of unknown composition. The pancreatic juice poured into the duodenum contains its proteolytic enzyme in the form of a trypsinogen which is activated immediately to trypsin by contact with the duodenal epithelium or with the secretion furnished by this epithelium. The activating substance is designated as enterokinase. It is present normally in the intestinal juice formed in this part of the alimentary canal, or it may be obtained in extracts of the mucous membrane of the duodenum or jejunum. According to Pawlow, however, the intestinal secretion obtained by direct mechanical stimulation of the epithelium is lacking in enterokinase. This latter substance is produced in fact only under the influence of some constituent of the pancreatic juice, possibly the trypsinogen itself. In other words it would seem that the enterokinase must itself be activated before it can fulfill its functions as an activator of the trypsinogen. The chain of inter-related processes occurring at this point in the act of digestion becomes somewhat intricate, as fol-

lows: Hydrochloric acid formed in the stomach and brought into the intestine with the chyme stimulates the epithelial cells of the intestine to form secretin and to pass it into the blood. The secretin conveyed by the blood to the pancreas stimulates this organ to secrete pancreatic juice. The pancreatic juice is carried to the duodenum and stimulates the epithelial cells to form enterokinase which then activates the trypsinogen to trypsin. Assuming that all of these steps are verified by future work, we have in this series of events an excellent example of chemical coordination, that is to say, of coordination effected by chemical stimuli conveyed from one organ to another through the liquids of the body. It may be noted in passing that the epithelial cells of the duodenum under the influence of acids or soaps form an internal secretion, the secretin, while under the influence of the pancreatic juice they produce an external secretion, the enterokinase. It is of course possible that these two different functions are subserved by separate cells, but so far as our evidence goes at present we must infer rather that one and the same epithelial cell gives either an internal or an external secretion according to the nature of the chemical stimulus acting upon it. While there can be no doubt at all of the existence of enterokinase and of its wonderful effect in activating almost instantaneously the trypsinogen of the pancreatic juice, much uncertainty prevails as to its nature and its mode of action. Pawlow thought that it belongs to the group of enzymes and this view has been supported in an almost convincing way by the experiments of Bayliss and Starling. In accordance with this view it is found that the substance exhibits a certain degree of thermolability, being destroyed at a temperature of 67 to 70° C., although in this respect it is less sensitive than most of the well-known enzymes. From this standpoint the action of the enterokinase upon the trypsinogen would come under the general head of catalytic reactions, but here again it is to be observed that its action differs from that of the other enzymes in the great rapidity with which it is completed, a rapidity quite comparable to that of ordinary chemical reactions. Other observers (Dastre and Stassano, Hamburger and Hekma, Cohnheim) have contended that the enterokinase unites permanently and quantitatively with the trypsinogen, after the manner of an amboceptor and complement, to form a new and active compound, the trypsin, and the whole reaction has been still further complicated by the discovery (Delezenne) that the trypsinogen may be activated by calcium salts without the presence of enterokinase. The action of the calcium requires some time for its development but when it occurs it takes place not gradually but abruptly, just as in the case of the activation produced by enterokinase. The further fact stated by Delezenne that the enterokinase itself needs the presence of calcium salts before it acquires the property of affecting trypsinogen suggests naturally the thought that the action of the enterokinase may be at bottom another case of calcium activation. Pozerski states that in the inactive pancreatic juice obtained by injections of secretin calcium is not present; whereas in the active juice following upon the use of pilocarpin, calcium is contained, and the digestive action of the juice runs parallel with the content in calcium. But whether the enterokinase acts as a ferment, or an amboceptor, or a calcium carrier it constitutes a special type of organic activator and this fact suggests the possibility that other processes in the body may be controlled by similar compounds.

At present only one other organic activator of this kind has been described, namely, the thrombokinase of blood coagulation. This hypothetical substance is given great importance in the theory of coagulation proposed by Morawitz. According to this theory the blood corpuscles under abnormal environment yield an unknown substance of colloidal nature which together with calcium is necessary for the complete activation of thrombin, and therefore for the clotting of blood. A similar kinase is furnished by the tissues in general, so that blood escaping from a vessel and coming in contact with the surrounding tissues obtains from them a kinase which accelerates the process of clotting. The evidence for the existence of this kinase is far less satisfactory than in the case of the enterokinase, indeed one may have serious doubts whether the facts at present warrant the assumption that a specific organic kinase must cooperate with the calcium in activating the thrombin, but if the idea is demonstrated to be correct it will furnish another very interesting example of the way in which chemical coordination may be employed in the body. In this case the blood may be supposed to stimulate the tissue cells to form a substance not directly of importance to their own activity, but which initiates the coagulation of the blood, stops the hemorrhage and thus saves the organism from destruction. The series of events is quite parallel to that described for the pancreatic juice and the enterokinase.

In addition to the activators of the inorganic and the colloidal type there is perhaps a third kind of activation exemplified in the substances known as coenzymes or coferments. This term may be used to define that kind of cooperative activity between an enzyme and some other non-colloidal substance which we see illustrated in the influence of the bile salts upon pancreatic lipase. The process differs from activation of a proferment to a ferment only in that the combination of the enzyme with its activator is dissociable instead of being permanent. By dialysis or otherwise the coenzyme can be separated from the enzyme and the action of the two may be tested separately or in combination. Perhaps this species of activation may be more common in the animal body then we have supposed. Bierry and Giaja have shown that the amylase of pancreatic juice loses its diastatic action entirely when dialyzed and this power or property is restored upon the addition of sodium chloride. It would seem from their experiments that the amylase is active only when combined with an acid ion, such as Cl or Br and the transition from one form to the other, from the active to the inactive or the reverse is easily accomplished. No one can doubt that all these forms of chemical activation are allied in a general way to the more interesting and obvious mode of chemical coordination illustrated by the hormones. Starling defines hormones as chemical messengers which formed in one organ travel in the blood stream to other organs of the body and effect correlation between the activities of the organ of origin and the organs on which they exert their specific effect. Such substances belong to the crystalloid rather than the colloid class, they therefore are thermostable and do not act as antigens when injected into the living animal. The general idea of this definition is clear and most suggestive, but in its details it is made especially to suit the case of secretin, and therefore may not fit so well for other substances of like physiological value. Conveyance through the blood stream, while certainly the most common occurrence for this class of bodies, ought not to constitute an essential part of their

definition. The secretin formed in the intestinal epithelial cell is conveyed to the pancreas in the blood and brings about a correlation between the activity of this gland and that of the duodenum, but on the other hand some substance contained in the pancreatic juice and conveyed to the duodenum in the stream of secretion excites the formation of the enterokinase, and thus correlates the activity of the duodenum with that of the pancreas. The two actions seem to be so similar, except for the means of transport, that one would naturally put them in the same class. By the same reasoning we might be justified in designating the hydrochloric acid of the gastric juice as a hormone in reference to its action in causing a formation of secretin in the epithelial cells of the duodenum. One can imagine that a similar transportation may occur in the secretions of the reproductive or respiratory passages, in the cerebro-spinal fluid, as seems to be the case for a time at least with the secretion of the pars intermedia of the pituitary gland, or even along the axial stream of a nerve fiber. If, as seems to me, the idea of correlation or coordination is the essential point rather than the assumption that the product must constitute an internal secretion, we might modify the definition so far as to designate as hormones those substances in solution which, conveyed from one organ to another through any of the liquid media of the body, effect a correlation between the activities of the organ of origin and the organ on which they exert their specific effect. As regards the nature of the action of the hormones on the organ affected we know too little to make any safe generalization. In the case of the secretin it seems most probable that the hormone arouses the pancreatic cells to an act of secretion and therefore it has in this instance the value of a chemical stimulus. But in other cases the effect of the hormone may be rather of the nature of an activation. This at least would seem to be true for the hormone, of unknown nature, given off by the pancreas and concerned in the glycolysis of sugar in the organism. The effect of the hormone adrenalin upon the musculature innervated by the sympathetic system may also be of the nature of an activation rather than of a chemical stimulation.

The substances of known composition which may be regarded as playing the rôle of hormones are few in number, three or four at most as follows: First, the carbon dioxide formed in the tissues, particularly in muscle during contraction. It seems agreed now that the carbon dioxide acts as the normal stimulus to the respiratory center. When produced in the working muscles in such quantities as to raise perceptibly the carbon dioxide tension in the alveoli of the lungs and the blood of the pulmonary veins, the respiratory center is excited to greater activity and the excess above the normal contents is thereby removed; second, the adrenalin of the adrenal glands which in some way, directly or indirectly, makes possible the full functional activity of the involuntary musculature of the body; third, the hydrochloric acid produced in the stomach which stimulates the formation of secretin in the duodenal epithelium; and fourth, possibly the iodothyrin of the thyroid gland with its dynamogenic effect upon the neuromuscular apparatus of the body. In addition there are a number of hormones of unknown composition which have been either proved or assumed to exist, and which are held responsible for certain well known correlations of function. The pancreatic secretin formed in the epithelium of the duodenum or jejunum which stimulates the flow of pancreatic secretion; the gastric

secretin formed in the plyoric mucous membrane which gives rise to the chemical secretion of gastric juice; a secretin formed in the duodenal epithelium which stimulates the formation of intestinal juice in the following segments of the intestine; unknown hormones of pancreatic origin which determine the absorption activity of the intestinal epithelium; vaso-dilator hormones formed in tissues in functional activity and which have a specific effect upon the vessels of the functioning organ; a vaso-constricting and a diuretic hormone formed in the posterior lobe of the pituitary body; a hormone controlling the growth of the bones and connective tissues produced in the anterior lobe of the pituitary body; a hormone controlling the oxidation of sugar in the body and produced in the cells of the islands of Langerhans in the pancreas; a hormone produced in the thymus which controls possibly in some way the development of the reproductive organs; a vaso-constricting hormone formed in the kidneys; a hormone in the salivary glands which controls the flow of water from the blood capillaries in the glands; a hormone produced in the fœtus in utero which stimulates the growth of the mammary glands; a hormone in the ovary which controls the growth of the uterus and the processes of menstruation; a hormone in the ovary which controls the implantation of the fertilized ovum and the growth of placental tissue; a hormone in the testis which initiates the development of the secondary sexual characteristics in the male; hormones of an indefinite number, produced in all the tissues and acting specifically upon the determinants in the gametes in such a way as to make possible the transmission of acquired characteristics. It is evident from this summary that there is a well developed tendency in physiology at the present day to utilize the conception of hormones to explain all relationships not otherwise intelligible. A few years ago the number of hypothetical enzymes in the body was likely to be increased whenever a new research in metabolism appeared, now the drift seems to be in the direction of manufacturing new hormones. This natural inclination to abuse a new and attractive idea will not of course prejudice us against the great importance of the suggestion which we owe to Bayliss and Starling. It is to be hoped only that no one will be tempted to give to these hypothetical hormones distinctive names, except in cases such as the secretin, adrenalin, etc., in which the substances have been isolated in some degree of purity. For once a specific name has become attached to an entirely unknown substance it acquires henceforth an easy currency in our literature, and soon many of us unconsciously assume that the thing so designated constitutes one of the verified facts of our science. By way of example one may cite the thrombokinase which has become such a familiar term in the literature of coagulation and which not infrequently is employed by writers as though its existence were a settled fact.

Among his other valuable suggestions regarding the characteristics of the hormones, Starling has called attention to the fact that some of them act by increasing the processes of disassimilation or catabolism, while others apparently stimulate the processes of assimilation or growth. In this latter group we may include the hormones of the anterior lobe of the pituitary body, according to the present conception of the functions of that gland, and all of the hormones of the reproductive cells. These latter have in general what has been designated as a dynamogenic action, they cause hypertrophies in various organs or tissues and invoke therefore processes of

synthesis rather than those of splitting and oxidation. Hypertrophy as an outcome of increased functional activity is a familiar phenomenon, but as Nussbaum remarks the hypertrophy induced by testicular or ovarian hormones resembles rather the effect of the growth energy exhibited by the developing embryo, in that it is dependent upon influences other than those arising from functional use. What these influences may be is at present a matter of pure speculation. In his recent most interesting contributions to our knowledge of growth Rubner has been led to assume that the property of growth in the young organism is connected with certain special chemical complexes in the protoplasmic material, complexes which have nothing directly to do with the simple maintenance of the nutrition of the cell and which after adult life is reached disappear for the most part from the general soma. In line with this hypothesis one might assume that the hormones given to the blood by the reproductive cells contain such complexes which when anchored in certain tissues lead to an accelerated growth. Perhaps the clearest and most interesting experiments made upon the reproductive hormones are those reported by Nussbaum. He chose for his experiments the males of *Rana fusca* whose reproductive organs go through a cyclical development each year. At the proper period the preparation for the mating season shows itself in the hypertrophy of the seminal vesicles, of the thumb pads and of certain muscles in the forearm. If the frog is castrated these hypertrophies do not occur, or if they have begun before the castration is performed retrogressive changes take place. On the other hand, the usual hypertrophy of the nuptial organs can be initiated in a castrated frog if pieces of the testis from another frog are introduced into the dorsal lymph sacs. The pieces thus introduced do not become grafted permanently but are gradually absorbed and the growth of the thumb pads and of the muscles in the forearms falls off after this absorption is completed. Nussbaum believes that the stimulating effect of the testicular hormones is not exerted directly upon the tissues which show the increased growth, but rather upon the portions of the central nervous system which innervate these tissues. This belief rests upon the experimental fact that if the peripheral nerves going to the glands and papillæ of the thumb pads are severed on one side the testicular hormone affects only the other intact side. This experiment and the conclusion drawn from it opens up the interesting question whether perhaps the reproductive hormones in general exert their effect through the central nervous system. This has not been the usual belief, and the experiments of Nussbaum are open to the obvious objection that the section of the peripheral nerves may have induced certain secondary changes in metabolism which indirectly antagonized the action of the testicular hormone. At present these experiments, so far as I know, have not been repeated with this objection in mind and it is somewhat gratuitous to criticize the author's conclusions until further work is reported.

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SIR WILLIAM CROOKES[1]

The generation just passing away and that now enjoying the vigor of its beginning, are fortunate in this country, because they are recognizing the privileges and advantages of anniversary celebrations. The indulgence in

[1] Address of Professor Charles Baskerville before the Chemists' Club, Harvard Night, November 27, 1909, on which occasion Sir William Crookes was elected to honorary membership in the club.

such celebrations is not empty sentimentality, but possesses a practical value. They not only acquaint us with past events, but develop a true appreciation of their historical significance; and more than that, they stimulate within a finer realization of the actuating motive of sentiment, which is, after all, the basis of sympathy, the torch that leads one along dark passages and warms the heart to the best endeavors.

On December 10, 1859, appeared the initial number of Volume I. of the *Chemical News*. This journal, founded, owned and edited by William Crookes, is well known to English reading chemists the world over. However, some of the circumstances of its founding and subsequent development may not be known to all present. I shall, therefore, venture to direct attention to one or two important events in its history. In 1843, William Francis and Henry Croft founded the "*Chemical Gazette*, or Journal of Practical Chemistry in all its applications to Pharmacy, Arts and Manufactures." This journal was conducted until 1859, when it was followed by the "*Chemical News;* with which is incorporated the *Chemical Gazette:* a Journal of Practical Chemistry in all its applications to Pharmacy, Arts and Manufactures." The last-mentioned journal was founded and edited by William Crookes. From Volume III., the title has been the *Chemical News and Journal of Physical Science.*

In introducing the *Chemical News* to the chemical public, it was stated in the first number that "the diffusion of facts which may tend to improve and augment our knowledge of the arts and sciences upon which most of the operations of civilized life are based, must be a pleasing task to those who hold in esteem the welfare of mankind. It is with this feeling that the *Chemical News* is introduced to the world." Further,

> . . . There is no weekly journal in England which has for its aim the publication of those scientific processes and discoveries, the knowledge of which tends so greatly to increase our importance as a nation devoted to improvement, refinement and industrial excellence. It is therefore to supply this deficiency that the *Chemical News* is now launched into the stream of scientific literature.

Although he did not bind himself to an inflexible rule of action, the plan laid out by the editor was as follows:

> Each number will be divided into several sections, which will have a general but no individual connection with each other. We shall commence with scientific and analytical chemistry, under which head will be given the results of elaborate investigations in the laboratory, by those pioneers of our science who by their labours pave the way for the subjects treated of in our next department—technical chemistry. Here will be described the practical applications of the processes, formulæ or chemical agents, which the labors of the purely scientific chemist have placed at the disposal of the manufacturer. In the department of agricultural chemistry especial care will be taken to place before the agriculturalists of the United Kingdom all the most interesting and useful information to be derived from Home or Continental sources, or from the States of America.
>
> Pharmacy, toxicology, &c., next follow, and the medical profession will here find from time to time everything of interest relating to Pharmacy, Materia Medica and Toxicology. Discussions upon medical reform and jurisprudence will also be freely admitted into these columns.

It was also announced that "The proceedings of the various learned societies in which the readers may be supposed to take particular interest will be given," as well as notices of books, patents, etc., and chemical notices from foreign sources, scientific notes and queries, laboratory memoranda, and answers to correspondents.

As the knowledge of chemistry was extended and the publication of other chemical journals devoted to special subjects was begun, the *Chemical News* has found it advisable to alter its original plan considerably; for instance, after the *Journal of the Society of Chemical Industry* was founded in 1882, it no longer remained the sole record for those interested in chemical manufactures; and the founding of various English journals on medical and pharmaceutical subjects has rendered the omission of these branches necessary.

The board of trustees of the Chemists' Club, in recognition of the successful completion of

the one hundredth volume of the *Chemical News* at the end of next month, unanimously resolved to forward a suitably engrossed letter of congratulations to Sir William Crookes. The letter has been prepared and reads as follows:

The Chemists' Club of the City of New York extends to Sir William Crookes, of London, hearty congratulations upon the completion of the one hundredth volume of the *Chemical News*, which, under his direction, has been so successfully devoted for a half century to "the diffusion of facts which may tend to improve and augment our knowledge of the arts and sciences upon which most of the operations of civilized life are based," and its members wish for him not only many more years in fruitful service, but that they and other men of science may profit by further additions to his already long list of rich contributions to theoretical specialized and practical scientific knowledge.

Morris Loeb, *President*

Parker C. McIlhinney, *Secretary*

Furthermore, the trustees unanimously voted to recommend that the club elect Sir William Crookes to honorary membership, and I was designated to present the matter to the club at this meeting. I perform this duty, which is a privilege, with extreme pleasure, and regard myself fortunate in being able to close my term as a trustee in paying a graceful tribute to one so deserving of our admiration and esteem, and one whose personal friendship I have enjoyed for a number of years.

William Crookes was born in London on June 17, 1832, and studied chemistry and later assisted Hofmann at the Royal College of Chemistry. In 1854 he became superintendent of the meteorological department of the Radcliffe Observatory, Oxford, and in 1855, professor of chemistry at the Science College, Chester ("Chester Training College"). In 1859 Crookes founded the *Chemical News*, to which reference has already been made; and in 1871 he became editor of the *Quarterly Journal of Science*, having previously served as coeditor with James Samuelson from the founding of the journal in 1864.

Crookes has been a fellow of the Royal Society since 1863, and was knighted in 1897. In 1887 he succeeded Dr. Hugo Müller as president of the London Chemical Society, serving two years. Crookes was elected president of the British Association in 1898, and, previously, in 1886, he had served as chairman of the chemical section. He has also been president of the Institute of Electrical Engineers. He has received honorary degrees of doctor of science from Oxford, Dublin and Cape of Good Hope universities.

Crookes engaged in original research at an early age, his first paper "On the Seleno-Cyanides" being published in 1851. In 1861 he discovered the element thallium, and in subsequent years investigated its properties and compounds. In 1865 he discovered the process of separating gold and silver from their ores by sodium amalgamation. In 1872 he was led by his experiments in determining the atomic weight of thallium to consider the subject of repulsion resulting from radiation, and invented the radiometer, which he afterwards modified as the otheoscope. He was engaged at the same time in examining the physical phenomena of modern spiritualism, and having become convinced of the existence of force exerted by an intelligent, disembodied agency, he announced his conclusions in his "Researches in the Phenomena of Spiritualism" (1874). Later Crookes pursued a course of investigation in regard to the properties of matter in a vacuum, and published some of the results in his "Molecular Physics in High Vacua" (1879). He asserted that he had discovered a fourth state of matter, the ultra-gaseous protyle, in which he maintained that the molecules are not in contact as in a liquid or gas, but isolated. Crookes's method of producing extreme vacua rendered incandescent electric lighting a practical possibility.

In 1880, in recognition of his discoveries, the French Academy of Sciences gave Crookes a gold medal and a prize of 3,000 francs. In 1875 the Royal Society awarded a Royal Medal to Crookes, and the same society awarded him the coveted Davy Medal in 1888, and the Copley Medal—"the ancient olive crown of

the Royal Society," as it was termed by Davy —in 1904. Three times has he been the Bakerian lecturer of the Royal Society.

Crookes has published the following treatises: "On Thallium" (1863); "On the Manufacture of Beet Root Sugar in England and Ireland" (1870); "Select Methods in Chemical Analysis" (1871, 1886, 1888, 1895); "A Practical Handbook of Dyeing and Calico Printing" (1874, 1883); "Dyeing and Tissue Printing" (1882); "La Genese des Elements" (1887); "Die Genesis der Elemente" (1888); "Elements et meta-Elements" (1888); a translation of Rudolf von Wagner's "Die Chemische Technologie" (1872, 1881, 1892); and several other less important translations and editions of German and French works on chemical subjects.

The list of his scientific papers would be too long to present here, but it may be said that Sir William Crookes is an authority on the rare earths and rarer elements, and on spectroscopy and sanitary science.

His investigations on the rare earths have been chiefly on the phosphorescence spectra of yttrium, samarium (cathode-luminescence spectrum) and erbia (luminescence spectrum); on the absorption spectrum of didymium; and on the separation of these earths and their distribution (universal distribution of yttrium and scandium). In 1899, Crookes announced the existence of a new element, *victorium*, earlier called *monium*, and previously (in 1886) he claimed to have discovered two new elements, *ionium* and *incognitum*. In 1876, Crookes devised the well-known "Crookes Tube," and in 1903 the spinthariscope. His investigations of the radio-active elements have also been noteworthy, and in 1900 he fractioned uranium nitrate into an inactive product, thereby obtaining an active substance, Ur-X.

In sanitary science, the important work of Crookes has been on sewage disposal, on water supply and contamination, on the use of disinfectants, and on the wheat problem.

Crookes has delivered the following addresses: "On Radiant Matter" (British Association, Sheffield Meeting, August 22, 1879); "On Radiant Matter Spectroscopy" (Bakerian Lecture, Royal Society, May 31, 1883); address to the chemical section of the British Association, Birmingham Meeting, September 2, 1886, dealing with the nature and origin of the so-called elements; "Genesis of the Elements" (Royal Institution, February 18, 1887); address as president of the Chemical Society, anniversary meeting, March 28, 1888; "On Recent Researches on the Rare Earths" (annual general meeting of the Chemical Society, March 21, 1889); "Diamonds" (Royal Institution, June 11, 1897); British Association Inaugural address, Bristol, 1898, dealing mainly with the "Wheat Problem"; and his admirable lecture on "Diamonds" before the British Association, Kimberley meeting, September 5, 1905.

Sunday evenings, Sir William is at home. Within his study walls, bebooked to the ceiling, one may find then the finest minds of science in England or other lands, grappling in discussion with the unsolved problems, which oftentimes become no clearer than the increasing denseness of the tobacco smoke. Promptly at eleven o'clock there comes a bright rift in the clouds as Lady Crookes enters and charmingly leads all to the dining room below.

Punctilious in the performance of every duty, courteous but vigorous in argument, modestly assertive, learning from the youngest, Sir William draws out the humblest until he would become almost bold, yet, in return, he gives generously from his rich store of wide knowledge and large experience. Such is the man the trustees would have the club honor and thus gain luster itself, for William Crookes, the *savant*, ornaments any company, and his life work is an inspiration for the present generation and the generations of men of science to come.

THE INTERNATIONAL AMERICAN CONGRESS OF MEDICINE AND HYGIENE

THE International American Congress of Medicine and Hygiene of 1910 in commemoration of the first centenary of the May revolution of 1810, under the patronage of his excellency, the President of the Argentine Republic,

will be held May 25 in Buenos Aires, Argentine Republic.

In order to facilitate the contribution of papers and exhibits from the United States, there has been appointed by the president of the congress, Dr. Eliseo Cantôn, and the Minister of the Argentine Republic at Washington, a committee of propaganda of which Dr. Charles H. Frazier (Philadelphia, Pa.) is chairman and Dr. Alfred Reginald Allen (Philadelphia, Pa.) is secretary.

The congress has been divided into nine sections, each section being represented in the United States by its chairman in this committee of propaganda as follows:

Section 1—Biological and Fundamental Matters, Dr. W. H. Howell, Baltimore, Md.

Section 2—Medicine and its Clinics, Dr. George Dock, New Orleans, La.

Section 3—Surgery and its Clinics, Dr. John M. T. Finney, Baltimore, Md.

Section 4—Public Hygiene, Dr. Alexander C. Abbott, Philadelphia, Pa.

Section 5—Pharmacy and Chemistry, Dr. David L. Edsall, Philadelphia, Pa.

Section 6—Sanitary Technology, Dr. W. P. Mason, Troy, New York.

Section 7—Veterinary Police, Dr. Samuel H. Gilliland, Marietta, Pa.

Section 8—Dental Pathology, Dr. George V. I. Brown, Milwaukee, Wis.

Section 9—Exhibition of Hygiene, Dr. Alexander C. Abbott, Philadelphia, Pa.

It will not be necessary for one contributing a paper or exhibit to the congress to be present in person. Arrangements will be made to have contributions suitably presented in the absence of the author. The official languages of the congress will be Spanish and English. Papers may be sent direct to the chairman of the particular section for which they are intended, or to Dr. Alfred Reginald Allen, secretary, 111 South 21st Street, Philadelphia, Pa.

SCIENTIFIC NOTES AND NEWS

President Taft has appointed Professor Henry S. Graves, director of the Yale Forestry School, as forester of the U. S. Forest Service to succeed Mr. Gifford Pinchot. He has also appointed Albert F. Potter, at present acting forester, as associate forester.

M. Emile Picard has been elected president of the Paris Academy of Sciences for 1910. He is succeeded by M. Armand Gautier as vice-president.

The Paris Academy of Sciences has awarded the Pontécoulant prize to Professor E. W. Brown for his work on the motion of the moon.

Sir James Dewar, F.R.S., has been elected a foreign member of the Reale Accademia dei Lincei, of Rome.

Professor Thomas Dwight, of Harvard University, was made an honorary member of the Anatomical Society of Great Britain and Ireland at the last annual meeting.

Colonel Charles Chaille-Long, the well-known American explorer, who served as chief of staff to General Gordon in the Sudan, has been awarded the gold medal of the American Geographical Society for his services to geographical science in Africa.

The Chemical Society, of London, in view of the completion of fifty years' fellowship by the past presidents, Sir Henry Roscoe, Sir William Crookes, Dr. Hugo Müller and Dr. A. Vernon Harcourt, will entertain these fellows as guests of the society at a dinner to be held some time at the end of May or the beginning of June.

At the annual election of the American Philosophical Society held on January 7 the following officers were elected for the ensuing year: *President,* William W. Keen; *Vice-presidents,* William B. Scott, Albert A. Michelson, Edward C. Pickering; *Secretaries,* I. Minis Hays, Arthur W. Goodspeed, James W. Holland, Amos P. Brown; *Curators,* Charles L. Doolittle, William P. Wilson, Leslie W. Miller; *Treasurer,* Henry La Barre Jayne; *Councillors* (to serve for three years), Edward L. Nichols, Samuel Dickson, Ernest W. Brown, Morris Jastrow, Jr.

The American Phytopathological Society elected the following officers for 1910 at its recent Boston meeting: *President,* Dr. F. L. Stevens, North Carolina Agricultural and

Mechanical College; *Vice-president,* Professor A. F. Woods, U. S. Department of Agriculture; *Secretary-Treasurer,* Dr. C. L. Shear, U. S. Department Agriculture; *Councillors,* Dr. L. R. Jones, University of Vermont, Professor A. D. Selby, Ohio Agricultural Experiment Station, and Professor H. H. Whetzel, Cornell University.

OWING to friction with some of the trustees, Professor E. Dwight Sanderson has been compelled to retire from the directorship of the Agricultural Experiment Station of the New Hampshire College.

DR. V. M. SPALDING, having retired from the staff of the Desert Laboratory, has removed from Tucson, Arizona, to Loma Linda, California, which will be his address for the present.

MAYOR GAYNOR has announced the appointment of Dr. Ernst J. Lederle as health commissioner of New York City to succeed Dr. Darlington. Dr. Lederle was health commissioner during the term of Mayor Low.

THE British Local Government Board has appointed Dr. Eastwood, one of the pathologists of the royal commission on tuberculosis, an additional medical inspector of the board, with a special view to his undertaking pathological investigations. Provision also has been made for the necessary assistance and laboratories. The immediate object will be to apply to public health work the results obtained by the royal commission on tuberculosis, and to ensure the freedom of important foods from infection.

WE learn from *Nature* that the following appointments have been made to the Indian Agricultural Service: Imperial agricultural bacteriologist, Mr. C. M. Hutchinson; supernumerary mycologist, Mr. F. J. F. Shaw; supernumerary agriculturist, Mr. G. R. Hilson. The two posts of assistant superintendent recently vacant in the natural history section of the Indian Museum, Calcutta, have been filled by the selection of Mr. Stanley W. Kemp and Mr. F. H. Gravely.

THE Swiss government will send a scientific expedition into the unexplored parts of Bolivia under the leadership of Professor O. Fuhrmann, of the University of Neuchâtel.

DR. G. C. BOURNE, M.A., D.Sc., Linacre professor of comparative anatomy, Oxford, delivered the Herbert Spencer Lecture at Oxford University on December 2. His subject was "Herbert Spencer and Animal Evolution."

A MONUMENT is to be erected to the memory of Laplace at Beaumont, in Auge (Calvados), where he was born in 1746.

THE Joseph Eichberg chair of physiology in the Ohio-Miami Medical College of the University of Cincinnati was formally established on December 11, at a meeting of the trustees of the Academy of Medicine. An endowment of $45,000 was raised for this chair by the academy and a few friends of the late Dr. Eichberg.

DR. LOUIS KRAUTER, assistant professor of botany in the University of Pennsylvania, and Mr. E. J. W. Macfarlane, son of Professor John M. Macfarlane, professor of botany in the university, were frozen to death when hunting near Wildwood, N. J.

DR. SHELFORD BIDWELL, F.R.S., known for his researches in electricity and optics, died on December 18, at the age of seventy-one years.

SIR EDWARD L. WILLIAMS, the British engineer, designer of the Manchester ship canal, died on January 1, at the age of eighty-one years.

M. BOUQUET DE LA GRYE, the eminent French hydrographic engineer and astronomer, has died at the age of eighty-two years.

PROFESSOR LORTET, honorary dean of the medical faculty in the University of Lyons, known for his work in archeology, has died at the age of seventy-three years.

DR. LUDWIG MOND, the eminent industrial chemist, has bequeathed £50,000 to the Royal Society and the same amount to the University of Heidelberg for the endowment of research in natural science, more particularly in chemistry and physics. The bequests take effect on the death of Mrs. Mond.

The estate of the late Dr. Thomas W. Evans has been settled after tedious litigation, and it is said that about $6,000,000 is now available for a museum and dental college in Philadelphia.

The annual message of Governor Hughes, of New York, announces the gift by Mrs. Harriman, in accordance with the plans of the late E. H. Harriman, of 10,000 acres of land and a million dollars for a state park in the Highlands on the west side of the river. Gifts for this purpose are also announced, amounting to $1,625,000 from Mr. J. Pierpont Morgan, Mr. John D. Rockefeller and others. These gifts are conditional on the sum of $2,500,000 being appropriated by the state, and are subject to certain other reservations.

Through the bequest of Miss Phœbe Anna Thorne, the American Museum of Natural History receives ten thousand dollars for its permanent endowment. The income of the fund is to be used in such a manner as to perpetuate the memory of her father.

The United States Pharmacopeal Convention will be held in Washington on May 10, 1910, for the first time as a corporate body. The chairman of the committee on credentials and arrangements is D. Oliver T. Osborne, of New Haven, Conn., and the secretary is Dr. Murray Galt Motter, 1841 Summit Place, N. W., Washington, D. C.

A joint committee of the Mathematical Association, London, and the Association of Public School Science Masters have been considering the possibility of correlating the teaching of mathematics and science, and have prepared a report on the subject. A joint meeting of the two associations was held at Westminster School on January 12, under the chairmanship of Professor Forsyth, F.R.S., to consider the report.

The fifth International Ornithological Congress will be held in Berlin May 30 to June 4, 1910, under the presidency of Dr. Anton Reichenow. The Congress will be organized in six sections: I., Anatomy and Paleontology; II., Systematic Ornithology and Geographical Distribution; III., Biology and Oology; IV., Bird Protection; V., Introduction and Acclimatization; VI., Aviculture.

The *Auk* states that in the alterations and additions to the Academy of Natural Sciences at Philadelphia that have just been completed, the ornithological department has been allotted half of the top floor of the main museum building, directly over the exhibition bird gallery. There is an abundance of light in the new quarters and the collection of skins is arranged to better advantage than ever before. The specimens, numbering upwards of 50,000, are arranged in 200 metal cases carrying trays 16×18 inches, and 50 large cases with trays 3×6 feet, while at the west end is a spacious work room and meeting room where the Delaware Valley Ornithological Club now holds its sessions. The exhibition series of mounted birds numbers about 10,000, besides which is a large collection of osteological material, nests and eggs.

The British government has promised £20,000 for the Antarctic expedition under Captain Scott, and about £12,000 has been subscribed from other sources. Reuter's agency states that progress is being made with the preparations. Dr. Wilson, chief of the scientific staff, will also be the zoologist and artist. It is anticipated that three geologists will accompany the expedition, and that one of these will be Mr. Mackintosh Bell, director of the Geological Survey of New Zealand, who has volunteered his services. Mr. R. Simpson, of the Indian Survey Department, will be the physicist. He is now on his way to England from Simla. A second physicist will be taken. There will be two, or possibly three, biologists. With Dr. Wilson will be associated a second medical man, who will study botany and bacteriology, giving particular attention to the investigation of blood parasites. The services of Mr. C. R. Meares, who lately completed a journey on the Chino-Tibetan border, have also been secured. He will leave England almost at once for eastern Siberia to obtain the ponies and dogs. He will collect the animals at Vladivostock, from

which place they will be sent to Kobe and trans-shipped from Australia and New Zealand. Mr. Meares will join the expedition in New Zealand.

THE third paper dealing with the results of the Smithsonian African Expedition under Mr. Roosevelt has been issued by the Smithsonian Institution as No. 1883 of the Miscellaneous Collections. It describes a new species of otocyon to which the specific name of *virgatus* is given. The animal is a small carnivorous mammal closely resembling a fox. It is generally buff in color and it has been found by Mr. Gerrit Miller, of the museum staff, to differ slightly from *Otocyon megalotis,* which occurs farther south, especially in color and in the characteristics of its teeth and skull. The otocyon is peculiar to Africa and is not represented in the United States, but resembles in color the swift or kit fox of the western plains. The skull of this new form closely resembles that of the gray fox of our native fauna.

THE *Experiment Station Record,* quoting from *Conservation,* states that the Biltmore Forest School, Biltmore, N. C., closed on November 1, when Dr. C. A. Schenck, who had been superintendent of the school for about fifteen years, severed his relations with the Biltmore estate. Some twenty-five of his students have signified their intention of continuing their work under his direction and will accompany him to Germany. A new school under his management is to be organized, to retain the name of the Biltmore Forest School, but instead of having a single fixed location it will carry on work over a wide range of forests. The principal headquarters will be in Germany near the Black Forest, where the school will be located for about six months each year. For the rest of the year practical work in the forests of Maine, Wisconsin and eastern Tennessee is contemplated.

THE *Journal* of the American Museum of Natural History states that the department of anthropology has recently been enriched by the accession of two large local collections. The first of these was made on Manhattan Island by Messrs. Calver and Bolton. It is particularly valuable, because the sites on the upper end of the island, whence the objects were obtained, are fast becoming obliterated. Several skeletons are particularly interesting as being the only authentic remains of the Manhattan aborigines known. There is also a large and perfect pottery vessel of the Iroquoian type from the upper end of Manhattan Island. The second collection was made on Staten Island during the years 1900–9 by Mr. Alanson Skinner, of the department of anthropology, and is the largest and most complete in existence from this locality, consisting of nearly 1,200 specimens.

STATEMENTS made to the United States Geological Survey by operators and others conversant with the coal mining industry indicate that the production of coal in the United States in 1909, while exceeding that of 1908, did not reach the high-water mark attained in 1907, the banner year of industrial activity in this country. It is, of course, impossible to give accurate information regarding tonnage, but it appears from the reports received from the coal-mining states by Edward W. Parker, statistician of the survey, that the increase in production in 1909 over 1908 was between 8 and 10 per cent., which would indicate a total production of from 440,000,000 to 450,000,000 short tons. Exclusive of the output from Sullivan County, the shipments of anthracite from the mines in Pennsylvania during the eleven months ended November 30, 1909, amounted to 56,194,447 long tons, against 58,837,076 long tons for the same period in 1908. It is estimated that the shipments in December will amount to 5,500,000 long tons. To the shipments should be added the usual percentage for local trade and colliery consumption and the production of Sullivan County, which would bring the total production of Pennsylvania anthracite in 1909 to approximately 71,150,000 long tons, or about 79,700,000 short tons, and the bituminous production will have amounted to between 360,000,000 and 370,000,000 short tons. The largest production from the anthracite

mines of Pennsylvania in 1908 was caused by a stimulated activity due to an apprehension of a suspension on April 1, 1909, when the wage agreements would terminate. This activity continued through the first three months of 1909, and the shipments in March, 1909, were the largest in the history of the trade. With the renewal of the wage scale in April, which was in fact a continuance of the awards of the anthracite strike commission for a third period of three years, production fell off, and the shipments of the summer months of 1909 were much less than in either 1907 or 1908.

The Department of Superintendence of the National Educational Association will meet at Indianapolis on March 1, 2, 3 and 4. With the department will meet the societies for the Scientific Study of Education, the Society of College Teachers of Education, the Conference of State Superintendents of Education, the National Committee on Agricultural Education, the Educational Press Association of America, the American School Hygiene Association, the American Physical Education Association and the Public School Physical Training Society. The National Educational Association will hold its annual meeting this year either in San Francisco or in Boston.

The opening of the International Scientific Congress to be held in Buenos Aires has been deferred from May 25, the original date, until July or August. The following Americans living in Argentina form a committee of the congress representing the United States: Professor Walter Gould Davis, chairman (chief of the Argentine Meteorological Service); Professor C. D. Perrine (head of the Córdoba Observatory); Professor R. H. Tucker (in charge of Carnegie Observatory, San Luis), and L. G. Schultz (chief of Magnetic and Solar Physics Division, Meteorological Service).

We are requested by the director of the Treptow Astronomical Observatory to print the following note in the "redactionnal part" of Science: "Professor Dr. A. Korn will be so kind as to hold some mathematical lectures about: 'Freie und erzwungene Schwingungen, eine Einführung in die Theorie der linearen Integralgleichungen,' in favor of the Treptow-Sternwarte. The inquisitions about this theory take a first place in the mathematical inquiries of our time, and have given us already well-known results in new forms, as well as completely new ones. The lectures will take place in the new auditory of the Treptow-Sternwarte, from January 20 till March 20, 1910, on every Monday and Thursday from 6–7 hour. (One lecture is on Thursday, January 20, 1910.)"

UNIVERSITY AND EDUCATIONAL NEWS

Mr. J. Pierpont Morgan has given $100,000 to Yale University, to establish a chair of Assyriology and Babylonian literature in memory of William M. Laffan, late editor of the New York *Sun*.

The directors of George Washington University have announced that they propose to raise an endowment fund of $2,000,000. Mr. Henry C. Perkins, a member of the board, made an initial subscription of $50,000 toward the fund on condition that the sum be raised.

Dr. Charles Graham, formerly professor of chemical technology in University College, London, has left his residuary estate (estimated to be £35,000) to the college for research in the School of Advanced Medical Studies of the University of London.

The new Carnegie Physics Laboratory, University College, Dundee, has been formally opened by Professor Sir Joseph J. Thomson, of Cambridge University.

Dr. John W. Baird, assistant professor of psychology at the University of Illinois, has been appointed professor of psychology at Clark University, to succeed Dr. Edmund C. Sanford, who has become president of Clark College.

Mr. F. J. M. Stratton has been appointed assistant to the professor of astrophysics in Cambridge University to succeed the late Mr. Cookson.

Dr. J. L. Simonsen, assistant lecturer and demonstrator in chemistry in the University

of Manchester, has been appointed professor of chemistry in the University of Madras, and Dr. A. Holt has succeeded him at Manchester.

DISCUSSION AND CORRESPONDENCE

INTERNATIONAL LANGUAGE

THE history of artificial languages for international communications presents some of the same features as many other human inventions. At first people began to work out such languages from so different points of view that the first attempts are extremely unlike one another and have only that one point in common that they are just as impracticable as the first flying machines were. But gradually all phantastic elements were eliminated, and now we have reached a period where practically every one works on the same basis and where only small differences are found between the various systems proposed or practised by all serious believers in an international language. As Ostwald puts it, "the international language is no longer the matter of more or less noisy enthusiasts, but a serious and technical problem, which we are going to solve just as well as we are solving the flying problem."

The first "universal languages," such as those of Dalgarno (1661) and Wilkins (1668), were "philosophical" or *a priori* systems, in which each thing was denominated according to its place in a universal logical system. In one *bu* is mammal, *be* fish, *ba* insect, the various orders and suborders being denoted by added letters and syllables; but as there is no earthly reason why we might not just as well use *ub* and *eb* and *ab* or *mi, mo, mu,* no two such systems have one syllable in common. The next step is represented by such languages as Schleyer's Volapük, which is only semi-philosophic, most of the words being English roots, many of them, however, strangely disfigured to fit in with the requirements of the completely philosophical and arbitrary grammar: *vol* = world, *pük* = speech, *Melop* = America, because no word was allowed to contain an *r* or to begin or end with a vowel, as that would interfere with Schleyer's prefixes and suffixes.

An enormous step in advance was made in Dr. Zamenhof's Esperanto (1887), because in the majority of words he retained the forms that were already international. But unfortunately he still has too many Volapükisms in his language. Not only does he disfigure many of the words taken from actual languages, as when *alert* becomes *lerta* (with an arbitrarily changed signification, too) or when French *aboyer* becomes *boji;* but he also quite arbitrarily coins some words with no foundation whatever in any language. As these are among the most frequently used in the language (pronouns, etc.) they give an air of strangeness and unfamiliarity to nearly every Esperanto sentence and probably more than anything else have deterred a great many people from taking the trouble to learn the language.

Since 1887, many people have worked out closely related artificial languages which all tend to keep the good features of Esperanto and to eliminate the bad ones. When the scientific committee elected by the Delegation for the Adoption of an International Auxiliary Language set to work in 1907, it found in the works of Liptay, Beerman, Molenaar, Peano and others, but above all in those of the "Academy" that had created the *Idiom Neutral,* a wealth of valuable suggestions all tending practically in the same direction, namely, in the direction of those elements of Esperanto which had never been criticized. On the other hand, it found an almost unanimous criticism of much in Esperanto not only on the part of believers in the possibility of an international language, but also on the part of such skeptics as the famous Leipzig philologists, Brugmann and Leskien; the points criticized in Esperanto were in all cases practically the same, namely, those in which Zamenhof had arbitrarily created something instead of finding out what was already the most international expression.

The language resulting from a careful investigation of all previous attempts is Ido: it must appeal to all unbiased minds because it is nothing but a systematic turning to account of everything that is already international,

that root being chosen in each case which will be most readily understood by the greatest number of civilized people. A few examples will show the contrast between Esperanto (given first) and Ido; I add the English translation:

bedauri—regretar, "regret";
chiu—omnu, "everybody";
eco—qualeso, "quality";
elparoli—pronuncar, "pronounce";
malsupreniri—decensar, "descend";
farto—stando, "state of health";
ghojo—joyo, "joy";
kial—pro quo, "why";
kiom—quanto, "how much";
neniam—nultempe, "never";
nepre—absolute, "absolutely";
parkere—memore, "by heart";
tago—jorno, "day";
vosto—kaudo, "tail."

Now, what has been the attitude of the Esperantists towards this new language? I am happy to say that a great many of them have frankly acknowledged its merits and are now active propagandists for it. If one looks through articles published before 1907 and sees the names there praised as those of the best Esperantists, one recognizes many of those who are now ardent Idists (Schneeberger, de Beaufront, Kofman, Lemaire, Ahlberg, Grillon). Among four Americans who were elected members of the Esperantist *Lingva Komitato,* three are now Idists. But on the other hand a great many Esperantists have stuck to the old language and tried to kill Ido, first by a conspiracy of silence and then by a misrepresentation of facts and of persons connected with the whole affair. And a great many people seem to take everything told in the Esperanto papers as truth instead of acquiring a first-hand knowledge of the new language. Two letters in Science of December 10 seem to call for an answer, as they are rather more fair than many articles in Esperanto periodicals. And I am thus obliged, against my usual practise, to say something about personal matters that have very little bearing on the real question at issue: it is not the persons supporting or deserting a language, but the essential features of the language that are of real importance in the long run.

Ever since the first appearance of the new language it has been the tactics of the Esperantists, not to examine the language itself, but to discredit it by relating how now this, now that member of the Delegation Committee had "resigned from it in disgust." Thus I read at one time in the *Amerika Esperantisto,* that Professors Jespersen and Ostwald had left the committee; this piece of news made a profound impression on me, though I must add that I know from the very best sources that it was not true. Now I read in Science that Professor Dr. Adolph Schmidt also is one of those members who left the committee. Unfortunately, I do not know just how deep my regret should be, as I have not the slightest idea who that gentleman is; the only thing I know with certainty is that he was not elected a member of said committee and was not present at a single one of its meetings, all of which I attended from beginning to end.

Only one member ever left our committee, and that was Professor Foërster, of Berlin, who saw fit to resign—exactly one year after the committee had finished its work and printed its official report. I fail to see the significance of his act of resignation at that moment, but it constitutes the only fact of what Mr. Spillman calls the disruption of the International Language Committee.

Mr. Spillman goes on to say that "these gentlemen are not at all agreed as to the structure of their language." It is a usual thing for Esperanto papers to say that we change our language about once a month. Now, I defy any one to find any difference between the first specimen ever printed in Ido and the language used in the very last issues of *Progreso* or *Belga Sonorilo,* etc. But the former periodical has invited criticism of Ido in a thoroughly open-minded and scientific spirit and has printed articles by authors experimenting with other "dialects"; but that of course does not change the language any more than Danish is changed by the admission in a Danish periodical of articles written in the closely related Norwegian and Swedish lan-

guages. I quote from the latest number (December, 1909) of *Progreso* a few lines which the readers of SCIENCE will be able to make out for themselves if I explain that *Fundamentists* are the orthodox Esperantists who look upon Zamenhof's *Fundamento* as a holy book of which not one jot or one tittle must ever be altered:

> La Fundamentisti, por salvar la lingual uneso [unity], supresas omna [all] libereso; ni [we] ne devas imitar li; ni devas, ne nur [only] tolerar, sed admisar la kritiko, nam [for] se ni ne admisus ol [it] inter ni, sub formo di amikal e bonvola diskutado, ol eventus exter ni, e konseque kontre ni; nulu povas [no one can] supresar, sufokar la kritiko; la max grava eroro e kulpo di l'Esperantista chefi esis, ke li malsaje [unwisely] volis exterminar ol ek lia armeo. Segun la paroli di So. Sterrett, la kritiko ne esas la morto, sed la vivo di ciencala entraprezo quale la nia [ours].

Thus on all points we substitute scientific methods and procedures for haphazard and arbitrary word-coinages and a blind swearing in the words of the "majstro" Zamenhof.

Just as some people have two religions, one for Sundays and another for week days, Esperanto has two spellings. One is the real thing with five circumflexed consonants; if you hand in a telegram in that orthography, it can not be correctly transmitted, and most printing offices can not print texts thus written; typewriters have to be specially equipped for these letters, and in ordinary writing they are cumbersome because the pen has to be lifted very frequently from the paper. No other system of artificial language has anything like these letters, which are thus shown to be unnecessary. Zamenhof himself in 1894 recognized these circumflexed letters as a "very important hindrance to the spreading" of Esperanto, but still he opposes any attempt to discard them and only allows his followers to use an *h* after the letter as a permissible spelling whenever the real Esperanto letters can not be had. This leads to such spellings as *hhemio*, which few chemists will gladly accept as the name of their science, and even in extreme cases to four successive *h*'s (monahhhhoro!). Therefore some Esperantists have tried other desperate remedies, writing *s'ang'o* or *sângô* instead of *sango* with circumflex over *s* and *g*, or *shangho* (Ido, *chanjo*). Whichever way you spell Esperanto, it looks unsightly, and in many cases unnecessarily alters the aspect of international words.

Mr. Kellerman finds that Ido is less musical and more monotonous than Esperanto; I have not yet found any one who was of the same opinion after listening to one half page of the same text translated into both languages, as the numerous *aj-oj-ujs* and the frequent sibilants of Esperanto are avoided in Ido. Mr. Kellerman also speaks of the "harsh Anglo-Saxon pronunciation of the letter *j*" in Ido. He will allow a phonetician to say that it is neither harsh nor Anglo-Saxon; besides, is Ido *joyo* harsher than Esperanto *gojo* with a circumflex over *g* or *ghojo*? The sound is identical in both cases, but Esperanto spells the initial sound in two ways unexampled in any language, living or dead, while Ido here as elsewhere selects the most international form.

The only refutation of Mr. Kellerman's assertion that Esperanto is more logical and more truly international than Ido and that Ido lacks definite rules is by a comparison of the two systems: I hope many of the readers of SCIENCE will undertake that comparison for themselves by a study of our grammars and readers or of parallel texts in both languages. Such an examination will soon make them see where the truth of the matter lies.

The main consideration with Mr. Kellerman seems, however, to be the number of adherents, and I must admit that Esperantists still are more numerous than Idists. But, as the boy said when applying for some work and being met with the objection that he was too young: "I shall improve in that respect every day." Ido certainly gained more followers in the first twelve months of its existence than Esperanto did in the first twelve years of its life. Mr. Kellerman quotes from the title page of the *Internacia Scienca Revuo* seventeen names of noted men of science who support that periodical. There is no doubt that *Scienca Revuo* would be a more valuable paper if these men also appeared inside the cover,

but as a matter of fact the great majority of them never published anything in Esperanto. Their support is purely platonic, and as it was given before the birth of Ido, it shows their approval of the general idea of an international language more than of that particular form of such a language. It is a significant fact that not a single philologist has accepted Esperanto in its Zamenhofian shape; the only one mentioned in Esperanto papers is Baudouin de Courtenay in St. Petersburg, but he has publicly declared that "Of course, Esperanto needs improvements," and though he does not accept Ido in every detail, he says that it is better than Esperanto in many respects. But the leading French Esperanto paper (*Lingvo Internacia*) refused to print a protest from Baudouin de Courtenay after they had printed what purported to be an article by him entirely in favor of Esperanto, which he had never written.

I am optimist enough to believe that the present tactics of many Esperantists will soon cease, and that they will then see that a good cause can only be furthered by a loyal discussion of the pros and cons without regard to persons. No great invention, no great scientific discovery, ever sprang into the world full-fledged; they all have required the patient cooperation of many minds. Yet we are to believe that Dr. Zamenhof's invention of 1887 stands in no need of improvement in its vital elements; and it is considered a sacrilege to whisper that its alphabet is cumbersome, many of its roots badly selected, much of its grammar too capricious and its methods of word-formation insufficient and amateurish, and that by setting to work on scientific principles it is possible to devise a much better language of a much more truly international character, "not perfect," perhaps, "but always perfectible."

Otto Jespersen

Columbia University

Scientists and Esperanto

In Science for December 3 appears an interesting note on Esperanto from the pen of Professor Tingle, in which he criticizes the statement made in a former article of my own, that the adoption of an international language is the solution of many difficulties for scientific men. Waiving the fact that he applies the quotation he makes in a manner other than the context will strictly warrant, his remarks still leave unshaken my conviction that the use of the international language would be a means of lightening the linguistic burdens of all scientific workers, and among them, of the chemists; even under the somewhat drastic conditions of the hypothetical case he cites.

I venture to believe, that if, as he supposes, subsequent to January 1, 1910, all chemical communications were compelled to be made in Esperanto, the result would not be, as he fears, simply the additional burden of another language to be learned, but that, on the contrary, chemists would discover that they did not need to be also expert linguists in order to keep in touch with the movements of their science throughout the world, and that, while possibly a *reading* knowledge of certain modern national tongues, for perusal of matter already chronicled, was still desirable, a *speaking and writing* knowledge, a very different matter, had become, almost, if not entirely, unnecessary in their scientific work. Such an intimate knowledge would be needed of one language only and that, the simplest of all, Esperanto. The authors of the communications would also find a much larger audience, to the advantage both of themselves and of the world in general.

It is true that sometimes, in quoting from existing writings, it is desirable to use the language in which the author wrote, in order to clearly express his thought, and to this extent would it be necessary to permit the use of other tongues than the international one, but this would be a very small item compared with the immense gain that all the new facts and theories of the science would be expressed in the world language, and, as the years rolled by, the necessity of using any national language in such international communications and contributions would grow less and less—to finally disappear.

Even the *reading* knowledge of natural tongues required for study or reference would be immediately reduced to a minimum, because large amounts of matter which at present are not translated into the national languages, for no other reason than that the demand for it in each tongue will not justify the expense, could be translated into the accepted international idiom, as it would then have the world for a market. Every year this minimum would steadily approach zero, as new theories and methods superseded old and were given to the world by their authors, in Esperanto.

The desirability of having an author's own words and expressions, whether one is studying him privately or quoting from his works, is only another reason why that author, when desiring to reach all the world, should write in a common tongue, which all the world can easily understand, and the acquisition of which, to those chemists or other scientists of the present day who already know English, French and German, is but child's play. Such should be willing to accept this "burden" (?), in order that their less gifted brethren may have also the advantages of reading in the original, scientific matter to be hereafter recorded.

We can not change the writings of the past, but the book of the future is ours to make or mar, and how better can we fill its pages than by recording the new triumphs of science in *one* language, an international language, which even her humblest worshipper may readily acquire?

J. D. HAILMAN

PITTSBURGH,
December 13, 1909

RELATIVITY AND SOME OF ITS CONSEQUENCES

THE discussion of relativity in the recent meeting of the American Physical Society in Boston was a serious disappointment to me. It interfered with some of my future plans, and it left me in the dark concerning how those plans might be amended.

I had intended, when I became a disembodied spirit, to start outwards from my space locus at that instant, and to travel with twice the velocity of light along my individual time emanations, until I had reached the beginning of my time career. I was, and am, curious to see how that history would appear when reviewed backwards in this manner. I had then planned to pause until my history should overtake me again. This would give me a chance to see myself as others had seen me. I had previously realized that this would be a cruise which would require a great deal of skill by reason of the constantly changing position of my individual time and space locus, due to terrestrial and solar motion. Still I had thought it possible to follow the tangled trail, by keeping my course at right angles to the daily and annual wave fronts, as they successively presented themselves.

It had seemed possible also to gain in this manner the experimental data necessary in the framing of a general system of vector analysis. This system would enable one to start with the space locus at which the earthly clay was shaken off, and to locate with reference to it any other point in his own time and space career. An increase in the length of the space vector in any direction would simultaneously carry one outward in space, forward in time and backward in history.

The Boston discussion did not supply one item of information which I had confidently expected. It is necessary that one should, on such a cruise, know the precise number of cubic miles in a cubic year. This information was not given us. In addition it was revealed that it is not possible for any velocity to be greater than that of light, or 3×10^{10} cm. per second.

Is this conclusion final? We can see that the waves which contain our spoken words lag greatly on those which embody our visible acts. May there not be some more refined medium, a spiritual medium, perhaps, in which v can exceed 3×10^{10} cm. per second?

Evidently we must no longer sneeze at discussions concerning the relation between the whereness of the when and the whenness of the where. The equations placed on that

Boston blackboard show that it may become possible to determine the relation between the present space locus of the instant when John Hancock finished his signature to a certain immortal document, and the present time locus of the point in space which his center of gravity then occupied.

Francis E. Nipher

"GEOMETRICAL" CANALS ON MARS? A SUGGESTION

At the present writing, Mars is traveling rapidly away from the earth, but, unfortunately, its mystery remains. Much was expected from the observations to be made at the recent opposition, the most favorable one in some respects since 1892; and the planet has in fact been studied eagerly and carefully with telescopes of many sizes and kinds, and all the resources made available by the advance in our knowledge of photographic and spectroscopic processes have been drawn upon to aid in solving the problems Mars presents. The details of these observations, for the most part, have not yet been published, but enough has been written to show that the average astronomer, as well as the intelligent layman, is left in as great doubt as to the actual configuration of the surface of Mars and the meteorological conditions prevailing there as he was a year ago.

Even the fundamental question as to the size of telescope best adapted to the study of planetary detail remains an open one. On the one hand, an expert areographer, owner of a 24-inch refractor, has repeatedly claimed for his telescope "greater space-penetrating powers" (due to the combined excellences of his lens and his atmosphere) than those possessed by any other in the world, and says that it is by virtue of these powers that he can see Martian details invisible elsewhere. On the other hand, an astronomer in charge of a much larger refractor has recently said that his telescope was *too powerful*[1] to show the canals on Mars. Again we are told that to get the best results in such studies we must use comparatively small telescopes or "cap down" the object glasses of the larger instruments—even a 24-inch aperture is improved by this process, it is said.

It is hardly necessary to call attention to the very diverse views held by areographers not only as to the interpretation to be put upon many of the markings observed on Mars —in particular, the geometrical network of the "canals"—but even as to their objective reality. Some optimists had hoped that photography would effectually dispose of all doubts on the latter point, and Mr. Lowell, indeed, has stated that his photographs have forever settled the matter. But one needs only to compare the drawing made by M. E. M. Antoniadi, himself an expert student of Martian topography, from forty of Mr. Lowell's photographs[2] with the direct prints from other photographs published by Mr. Lowell himself[3] to realize that the "doctors disagree" as earnestly as ever. It would seem that the time has come for the experts to reach some definite agreement on these questions, and it is because I have a suggestion to offer that appears to be practicable and that would, if followed, undoubtedly clear the atmosphere, that I, who am merely an interested student, not an expert, have ventured to write this note.

Mr. Percival Lowell has long been known as the chief advocate of the view that the Martian "canals" and other delicate surface markings on the planet which he has so fully observed and described are objective realities, and that they offer unmistakable evidence of intelligent life on the planet. He has not only published his observations and conclusions in detail in technical publications, but he has also written several popular books on Mars—"science that reads like romance"—to support these views. He has also claimed over and over again that his telescope and his geographical location give him facilities for

[1] It is rather amusing, by the way, to note that some of our European friends seem to have missed entirely the point of this remark and have, indeed, taken it so seriously as to be offended!

[2] *Monthly Notices Royal Astronomical Society*, Vol. LXIX, p. 110, 1908.

[3] *Proceedings of the Royal Society of London*, Series A, Vol. 177, p. 132, 1906.

Martian study not enjoyed by any one elsewhere.

Suppose, then, that Mr. Lowell invite two or three other well-known expert students of planetary detail—say, for example, Mr. E. E. Barnard, of the Yerkes Observatory; Mr. W. H. Pickering, of Harvard College Observatory, and Mr. E. M. Antoniadi, of l'Observatoire de Juvisy—to come to Flagstaff and join him in observing Mars at its next opposition. Would not astronomers and the public generally accept as objective realities any surface markings observed, either visually or photographically, by all four of these experts?

These experts might perhaps also undertake, during their residence at Flagstaff, to verify the remarkable and intricate network of markings on the planets Venus[4] and Mercury[4] which have been seen at the Lowell Observatory, and only there, so far as I am aware, and which, to the uninitiated, present many points of resemblance to the "canal" system on Mars. The fact that all the members of the Lowell Observatory staff are able to see so many of these markings which, apparently, are invisible from other stations, would seem to lend additional interest to my suggestion.

Great as have been Mr. Lowell's services in stimulating zeal in planetary studies, in no way, I think, could he add more to the sure advancement of our knowledge in this field than by inviting such a committee of experts to share with him, for a time, the advantages offered by his excellent telescope and favorable atmosphere.

R. G. AITKEN

December 8, 1909

SCIENTIFIC BOOKS

The Human Body and Health. An Intermediate Text-book of Essential Physiology, Applied Hygiene and Practical Sanitation for Schools. By ALVIN DAVIDSON, M.S., A.M., Ph.D., Professor of Biology in Lafayette College. New York, American Book Company.

This is an aggressive book. It abounds in plain statements that attract the reader and lead him on.

The author's motive and plan is indicated in the preface as follows:

> A few minutes' reflection in regard to the modern ways of living will fix in the mind of the sound reasoner the conviction that we are a careless and cruel people. Nearly one thousand human beings in the United States are dying daily of diseases which science has shown how to prevent. Streams are polluted, garbage dumped on the nearest vacant lot, fresh air and sunshine shut out of the houses by double doors and windows, and innocent children fed dirty milk because people do not realize that these acts are responsible for many of the four thousand graves daily made in our nation's cemeteries.
>
> Sanitary science and the public health can be advanced only as they are supported by an intelligent public opinion; . . . new ideas are grasped most readily by the young. Parents do not recognize that eyesight is being impaired, normal growth prevented, blood poisoned and the body starved because of customs and habits born in ignorance. . . . Anatomy and physiology is of little value to our young folks unless it helps them to practise intelligently in their daily lives the teachings of hygiene and sanitation. . . . Specific facts and full explanations are given showing how disease is caused and how the body may be kept well and strong. . . .

The contents of the book are as follows: Chapter I., The Human Body as a Living Machine; chapter II., Plants and Animals Related to Health; chapter III., The Plan of the Human Body; chapter IV., Food for the Body; chapter V., The Care and Cooking of Food; chapter VI., How Food is Used by the Body; chapter VII., Drink and Health; chapter VIII., Tobacco and other Narcotics and their Effect on Health; chapter IX., The Blood and its Passage through the Body; chapter X., Breathing and its Use; chapter XI., Air and Health; chapter XII., Cleanliness and Warmth; chapter XIII., Clothing and Colds; chapter XIV., The Bones; chapter XV., The Muscles and Exercise; chapter XVI., How the Body is Governed; chapter XVII., The Care of the Nervous System and

[4] For the markings on Mercury see *Popular Astronomy*, Vol. IV., p. 360, 1897; for the markings on Venus, *The Popular Science Monthly*, Vol. LXXV., p. 521, 1909.

how Narcotics Effect it; chapter XVIII., Organs for Receiving Knowledge; chapter XIX., The Cause of Sickness; chapter XX., How to Keep Well.

The book is well supplied with illustrative cuts which for the most part are fairly good. The representation of the tubercle bacillus on page fifteen is hardly typical of that organism. The red-blood cells are described as cup-shaped (p. 79). This is, or has been, the teaching in the Harvard laboratories, but is not generally accepted.

The eustachian tube is represented as entering the middle ear at a level lower than that of the fenestra rotunda and inferior margin of the tympanum (p. 177).

A few criticisms of the text may be advanced as follows:

Page 15: Measles is given as a bacterial disease. This has not yet been proved. The author recognizes that fact on page 191.

Page 16: It is stated that "our common disease bacteria do not have spores. . . ." The bacillus of tetanus that figures so extensively in our Fourth of July mortality is a spore-forming bacterium; the bacillus of tuberculosis is thought at times to show spore formation; other pathogenic spore-forming bacteria are the bacillus of anthrax, the bacillus of malignant œdema.

Page 18: "Yellow fever and . . . are caused by tiny animals. . . ." This is probably true, but the fact remains that the specific cause of yellow fever has not yet been demonstrated.

Page 19: It is stated that the ova of head lice may be removed by washing the hair "two or three times" with "soap and equal parts of vinegar and hot water." This is a disappointing treatment. The patient is lucky if he escapes without a close hair cut. At best the ova may otherwise be removed only by hours of careful combing.

Page 35: The question is asked: "Why is it harmful to eat more than the body needs?" According to some of our best authorities it is impossible not to eat more than the body needs.

Page 37: Scarlet fever is referred to as a bacterial disease. The fact that the specific cause of this disease has not been found is recognized on page 191.

Page 44: Reference is here made to mucus as having "the power to kill many harmful bacteria and thus protect the body from disease." Our authorities on the flora of the normal mouth, nose and throat tell us that these regions may contain a score or more of varieties of bacteria, including such forms as the staphylococcus and streptococcus pyogens, pneumococcus, bacillus of diphtheria and the meningococcus.

Page 50: A description of "stomach digestion" is given here with no reference to the fact established by Cannon that salivary digestion is continued for some time after the food has reached the cardia.

Page 67: The carbonated drinks are here stated to be healthful when used in moderation. It must not be forgotten that soda water, ginger ale, and so on, are responsible for a great deal of indigestion. The specialists in our large skin clinics spend a good deal of time proscribing these drinks.

Pages 90 and 122: Turpentine and alcohol are recommended as antiseptic washes for fresh wounds. This is severe treatment. Turpentine and alcohol are very painful when applied to raw surfaces.

Page 107: ". . . impure air is heavy and near the floor." This statement is startling. In view of the fact that it is at variance with the teachings of hygiene for many years, it must be backed up with a careful array of significant experimental facts before it can be credited. The single experiment offered in the text does not suffice.

Page 121: "To avoid dandruff, the scalp should be thoroughly washed with soap and warm water once or twice a month." The avoidance of dandruff is not so simple. If much reliance is placed on this advice it will lead to disappointment.

Page 194: ". . . and numerous cases are on record where the use of milk from sick cows has given the disease [tuberculosis] to children." There is good reason for being afraid of milk from tubercular cows in spite of the fact that some of our very best authorities are not disposed to agree that there are numerous

authentic cases of human tuberculosis from this source.

A special effort is made throughout this book to present the evil effects of the use of alcohol and tobacco. This is legitimate and worthy, but one can not help asking if it is not overdone. Young people are not stupid. It is not wise to place extreme statements before them. They are very likely to discover that some of the most successful men in every branch of life smoke or drink more or less. They may find the practise in their own deservingly respected parents. They are likely to ask if the fishes on pages 72 and 111, which died in twenty-five minutes from the poison soaked out of tobacco placed in their aquaria would not have died just as quickly if tea leaves or coffee grounds or boiled cauliflower, onions or table olives had been substituted for the tobacco; or if any other smoke passed through the aquarium of the fish on page 168 would not have been as disastrous as the tobacco smoke which took that fish's life. These experiments should be checked up with controls. There are enough indisputable facts pointing to the evil effects of alcohol and tobacco to furnish sufficient argument against their unwise use.

THOMAS A. STOREY
COLLEGE OF THE CITY OF NEW YORK

Catalogue of the Lepidoptera Phalænæ in the British Museum. Volume VII., 1908; Volume VIII., 1909. By Sir GEORGE F. HAMPSON, Bart.

The present volumes deal with part of the subfamily Acronyctinæ of the family Noctuidæ. This subfamily will be treated in three volumes, of which these are the first and second. Volume VII. comprises 843 species in 96 genera, Volume VIII., 720 species in 104 genera. The key to the genera of the Acronyctinæ given in Volume VII. is reprinted in Volume VIII. with some additions and corrections and with the references to pages added. A large number of the genera are new, and their appearance in print without citation of species under them is rather unfortunate, as the proper citation of species will not occur until Volume IX. appears. In the meantime, students using the tables are liable to make use of these names. As we understand the rules, such use would appropriate the authorship of the generic names, and we have ourselves avoided using them on several occasions. Sir George Hampson follows the general plan of the preceding volumes, so useful and well received by the entomological public. It goes without saying that the majority of our familiar names are changed. But this is something that we have learned to expect and is, indeed, quite unavoidable, as never before have the moths of the world been consistently classified by an author so capable in the subject and so well supplied with material. An incidental result of the continued appearance of these volumes is the enabling of the general student to determine North American noctuids independently. Heretofore, there have existed no general tables of genera and species anywhere nearly up to date, so that it has been practically necessary for the last thirty years to refer doubtful specimens to a single student who has made this field his own. The relief now being afforded from this condition is gratifying.

HARRISON G. DYAR

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Biological Chemistry, Vol. VII., No. 1, issued December 21, contains the following: "The Iodine Complex in Sponges (3,5-Diiodotyrosine)," by Henry L. Wheeler and Lafayette B. Mendel. Decomposition of ordinary bath sponges by barium hydrate yields 3,5-diiodotyrosine (iodgorgoric acid). "On the Preparation and Properties of Iodomucoids," by Gustave M. Meyer. Treatment of tendomucoid with iodine in alkaline solution produces iodo-mucoids, containing about 14 per cent. of organic iodine. "Lactic Acid in the Autolyzed Dog's Liver," by Tadasu Saiki. The lactic acid formed in liver autolysis is largely sarcolactic acid. "Liquid Extraction with the Aid of Soxhlet's Apparatus," by Tadasu Saiki. An adaptation of the usual form of Soxhlet's apparatus for extraction of liquids. "A Study of the Chemistry of Cancer: II., Purin Bases, Creatin and Creatinin," by Tadasu Saiki. Analyses of

fresh carcinomata. "A Note on the Estimation of Purin Nitrogen in Urine," by Stanley R. Benedict and Tadasu Saiki. Preliminary addition of acetic acid to urine makes the Krüger-Schmid method more accurate. "On the Neutrality Equilibrium in Blood and Protoplasm," by Lawrence J. Henderson. An answer to Robertson (*Journ. Biol. Chem.*, VI., p. 313, 1909). "Observations on the Influence of Lactic Acid Ferments upon Intestinal Putrefaction in a Healthy Individual," by Helen Baldwin. Addition of lactobacilline, bacillac or zoolak to diet did not diminish urinary evidence of intestinal putrefaction. "The Catalytic Action of Amino-acids, Peptones and Proteins in Effecting Certain Syntheses," by H. D. Dakin. Condensation (*in vitro*) of furfurol and malonic acid to furfuracrylic acid may be accomplished by the catalytic action of glycocoll. A number of similar reactions are described. "Note on the Urorosein Reaction," by H. D. Dakin. Criticism of work of Ciusa and Terni. "Notes on the Action of Sodium Benzoate on the Multiplication and Gas Production of Various Bacteria," by C. A. Herter. Sodium benzoate in a concentration of 0.1 per cent. only slightly or moderately inhibits intestinal bacteria. Gas-production may be considerably diminished. Inhibition of the *B. coli* group is greater than that of coccal forms.

THE AMERICAN MATHEMATICAL SOCIETY

The sixteenth annual meeting of the society was held at Boston on Tuesday, Wednesday and Thursday, December 28–30, 1909, in affiliation with the American Association for the Advancement of Science. Tuesday afternoon was devoted to a joint session with Sections A and B of the association. A joint session was held with Section A on Wednesday morning, the program consisting of Professor Keyser's vice-presidential address "On the Thesis of Modern Logistic," a report by Professor D. E. Smith on "The Work of the International Commission on the Teaching of Mathematics," and the first two papers in the list below. Separate sessions of the society were held on Wednesday afternoon and on Thursday morning and afternoon. On Tuesday evening several members took advantage of an invitation to attend the dinner and smoker of the Association of Mathematics Teachers in New England. The annual dinner of the society took place on Wednesday evening, forty-seven members gathering for this agreeable occasion. Much credit for the success of the meeting must be given to the local committee on arrangements, Professors Tyler, Bartlett and Bouton.

The total attendance at the annual meeting included sixty-one members of the society. Ex-president H. S. White and Professor E. W. Brown occupied the chair alternately during the several sessions. The following persons were elected to membership: Professor R. M. Barton, Dartmouth College; Dr. J. R. Conner, Johns Hopkins University; Miss Eva M. Smith, London, England. Nine applications for membership were received.

The reports of the treasurer, auditing committee and librarian will be published in the Annual Register, now in press. The membership of the society has increased during the past year from 601 to 618, including at present 58 life members. The number of papers presented at all meetings during the year was 149. The total attendance of members at the meetings was 311. The treasurer's report shows a balance of $8,003.78, of which $3,581.70 is credited to the life-membership fund. Sales of the society's publications during the year amounted to $1,748.90. The library has increased to nearly 3,300 volumes. A separate catalogue of the library, corrected to January 1, 1910, will soon be issued.

At the annual election, which closed on Thursday morning, the following officers and other members of the council were chosen:

Vice-Presidents—L. E. Dickson, J. I. Hutchinson.

Secretary—F. N. Cole.

Treasurer—J. H. Tanner.

Librarian—D. E. Smith.

Committee of Publication—F. N. Cole, E. W. Brown, Virgil Snyder.

Members of the Council (to serve until December, 1912)—D. R. Curtiss, L. P. Eisenhart, J. C. Fields, P. F. Smith.

The following papers were read at this meeting:

F. L. Griffin: "Certain tests comparing areas and other geometrical magnitudes."

G. A. Miller: "Groups generated by two operators s_1, s_2 satisfying the equation $s_1 s_2^2 = s_2 s_1^2$."

H. M. Sheffer: "Total determinations of deductive systems with special reference to the algebra of logic."

R. G. D. Richardson: "The Jacobi criterion in

the calculus of variations and the oscillation of solutions of m linear differential equations of the second order with m parameters."

J. V. McKelvey: "The groups of birational transformations of algebraic curves of genus five."

J. L. Coolidge: "The representation by means of circles of the imaginary elements of a three-dimensional domain."

L. C. Karpinski: "Jordanus Nemorarius and John of Halifax."

H. H. Mitchell: "The subgroups of the collineation group of the finite plane, $PG(2p)$."

W. H. Jackson: "Differential and integral equations arising out of the theory of radiation."

G. D. Birkhoff: "The stable solutions of the problem of three bodies."

W. D. Cairns: "The solution of the Lagrange equation in the calculus of variations by means of integral equations."

Arthur Ranum: "On the line geometry of riemannian space."

H. F. MacNeish: "Linear polars of quantics which are completely reducible to the product of linear forms."

E. V. Huntington: "An elementary explanation of the precession of a gyroscope."

C. J. Keyser: "Relational groups."

Edward Kasner: "Thomson and Tait's theorem on conservative forces."

Edward Kasner: "Note on Lamé's families connected with dynamics."

Arthur Ranum: "On Clifford parallels and Clifford surfaces in riemannian space."

The Chicago Section of the society held its twenty-sixth regular meeting at the University of Chicago on Friday and Saturday, December 31–January 1, the program including twenty-five papers. The next meeting of the society falls on Saturday, February 26. The San Francisco Section will meet on the same day at Stanford University.

F. N. COLE,
Secretary

SOCIETIES AND ACADEMIES

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

THE thirty-sixth meeting was held at the Rockefeller Institute for Medical Research on December 15, 1909, with President Lee in the chair.

Members present: Atkinson, Auer, Banzhaf, Beebe, Brodie, Cole, Famulener, Gay, Gies, Harris, Jackson, Joseph, Kast, Lamar, Lee, Levene, Levin, Lewis, Lusk, Mandel, Maury, Meltzer, Morgan, Murlin, Morse, Opie, Pearce, Rous, Shaffer, Shaklee, Van Slyke, Wallace, Wolf.

Members elected: Stanley R. Benedict, Alfred F. Hess, A. W. Hewlett, J. F. McClendon, Raymond Pearl, A. I. Ringer, A. O. Shaklee, Sutherland Simpson and Hugh A. Stewart.

Scientific Program

"The Conglutination Reaction as a Method of Serum Diagnosis in Acute Infections," F. P. Gay and W. P. Lucas.

"Analysis of the Cleavage Products of the Nucleoprotein of the Mammary Glands," John A. Mandel.

"Respiration by Continuous Intra-tracheal Insufflation of Air" (a demonstration), S. J. Meltzer and J. Auer.

"Demonstration of Animals whose Thoracic Organs have been Operated upon," A. Carrel.

"The Mutual Life-saving Antagonistic Action of Barium and Magnesium" (a demonstration), D. R. Joseph and S. J. Meltzer.

"Acute Anaphylactic Death in Guinea-pigs: Its Cause and Possible Prevention" (a demonstration), J. Auer and P. A. Lewis.

"Anaphylactic Shock in the Dog," R. M. Pearce.

"The Cause of Serum Anaphylactic Shock and some Methods of Alleviating it," J. F. Anderson and W. H. Schultz.

"A Model Illustrating the Mode of Action of the Glomerulus," J. G. Brodie.

"The Influence of Glycerin on Gastric Secretion," L. Kast.

"The Summation of Stimuli," Frederic S. Lee and Max Morse.

"The Action of Magnesium Salts: (*a*) In Relation to Motor Nerve Impulses, (*b*) In Relation to Sensory Stimulation," A. H. Ryan and F. V. and C. C. Guthrie.

"The Effects of Direct Application of Magnesium Salts: (*a*) To Motor and Sensory Nerves, (*b*) To Cardio-inhibitory Nerves," C. C. and F. V. Guthrie and A. H. Ryan.

"The Survival and Growth of Subcutaneously Engrafted Ovarian and Testicular Tissue," C. C. Guthrie.

"The Survival of Engrafted Thyroid and Renal Tissue," C. C. Guthrie.

"The Effect of Anemia and of Double Hyperemia on Hyperplastic Goiter," C. C. Guthrie.

"A Method for the Determination of Amino-nitrogen and its Applications," Donald D. Van Slyke.

"Note on the Production of Glycosuria by Pan-

creatic, Parathyroid and Infundibular Extracts," Isaac Ott and John C. Scott.

"The Immunity of the Eggs of *Ciona intestinalis* to its 'own' Spermatozoa," T. H. Morgan.

"A Report on Experimental Poliomyelitis," Simon Flexner and Paul A. Lewis.

"The Influence of Thyroid-parathyroid-ectomy on the Ammonia Destroying Power of the Liver," A. J. Carlson and Clara Jacobson.

"The Relation of Ptyalin Concentration to the Diet and to the Rate of Salivary Secretion," A. J. Carlson and A. L. Crittenden.

"On Non-specific Complement Fixation," Hideyo Noguchi.

"Experimental Cirrhosis of the Liver," Eugene L. Opie.

"Shaking Experiments with Protozoa," Max Morse.

EUGENE L. OPIE,
Secretary

THE ACADEMY OF SCIENCE OF ST. LOUIS

THE academy met at the Academy Building, 3817 Olive St., Monday, December 20, 1909, at 8 P.M., President Trelease in the chair.

Dr. Victor E. Emmel, of the anatomical department of Washington University, presented a paper entitled, "Observations on the Differentiation of Regenerating Epidermal and Striated Muscle Tissue," illustrated with a number of slides under the microscope.

Professor Nipher presented some of the results of his recent work on electric discharge. He has devised a series of experiments on the separately grounded terminals of an electric machine, which prove conclusively that the negative terminal is in a condition of compression, and that the positive is in a condition of electric rarefaction. The negative glow is a discharge of negative electricity from the negative wire to the air and surrounding objects. The positive glow is a flow of negative particles from surrounding bodies and from the air, to the positive side of the machine.

The evidence was obtained by passing the positive and negative wires to separate grounds, through high resistances, consisting of wetted strings. Between these resistances and the machine terminals, these wires pass in a horizontal direction over photographic plates. Other independent ground wires terminate just below the center of the plates, and under the wires.

In a spark discharge from the positive terminal negative electrons pass upward from the ground wire and fog the central part of the film from the under side. Negative discharges, flowing over the top of the film to the positive wire, curve around the fogged area. They are repelled by it. On the other plate negative electrons pass downward from the lower side of the plate to the ground wire. The central area of the plate does not repel the outflowing discharge from the negative wire to the film. On the contrary, it attracts them. The discharge lines over the film are nearly parallel, but diverge slightly at their outermost ends.

MARY J. KLEM,
Librarian

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

THE fourth regular meeting of the session of 1909–10 was held at the Chemists' Club on January 7.

The following papers were read:

"The Origin of the Chemical Elements," by Henry B. Russell.

"Chemical Examination of Watermelon Seed" and "Chemical Examination of Pumpkin Seed," by F. B. Power and A. H. Salway.

"Further Researches in the Quinazoline Field," by C. G. Amend and M. T. Bogert.

C. M. JOYCE,
Secretary

RHODE ISLAND SECTION

THE regular meeting of the section was held at the University Club on Thursday evening, December 2, at seven o'clock, preceded by the usual informal dinner.

Dr. H. J. Wheeler, director of the Rhode Island Agricultural Experiment Station at Kingston, R. I., read the paper for the evening and a large audience listened to the interesting report which he presented. His subject was "The Influence of Sodium and Potassium Salts upon the Subsequent Yield of Potato Tubers planted under Like Manurial Conditions."

The results obtained showed that when potatoes that had been grown with a predominance of sodium salts in the soil and those that had been grown with a predominance of potassium salts were planted side by side under identical conditions and manured equally, the best yield was obtained from the tubers that had been grown in the soil containing the extra sodium.

ALBERT W. CLAFLIN,
Secretary

PROVIDENCE, R. I.